Health Council of the Netherlands

Crop protection and local residents

2014/02E

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Gezondheidsraad
Health Council of the Netherlands

To the Minister for the Environment
and the Minister for Agriculture

Subject : presentation of advisory report *Crop protection and local residents*
Your reference : DP/2011043142
Our reference : I-828-11/HvD/pm/887-K1
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Dear Ministers,

On 18 April 2011, your predecessors requested the Health Council of the Netherlands' advice concerning the potential health risks posed by the use of chemical plant protection products to those living in the vicinity of agricultural land. As requested, the Council issued an initial advisory letter in September 2011. That document focused on the usefulness and necessity of a study conducted among local residents. In the advisory letter, the Council announced that an ad hoc committee would draft a more extensive advisory report on the options presented by various types of study. In that document, the other questions that had been posed would also be answered. That advisory report was prepared by the Health Council's Committee on Crop Protection and Local Residents and completed following an assessment by the Standing Committee on Health and the Environment. It now gives me great pleasure to be able to present this to you. The main thrust of this report is that exposure to chemical plant protection products from surrounding agricultural land merits serious attention and that there is a clear need for further research and for measures to limit exposure. I endorse the Committee's analysis, conclusions and recommendations.

In their request for advice, your predecessors specifically asked the Council to involve local residents in the preparation of the advisory report. The Committee interpreted that request in broad terms, and also asked representatives of the various agricultural sectors, commerce, and the agrochemical industry for their input. Two hearings were staged for this purpose: one at the start of the advisory process and one at the end. A public draft advisory report has also been issued, and anyone who so wished could submit comments. The hearings were well attended, particularly pleasant, and extremely informative for the Committee. People made extensive use of the opportunity to submit comments on the draft text of the advisory report. All this has contributed to the quality of the advisory report.

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Accordingly, I am very grateful to all of these stakeholders for their highly constructive contributions. I anticipate that the procedure followed will have greatly enhanced the advisory report's usefulness, in terms of your policy.

Yours sinerely,
(signed)

Professor P. van Gool,
President

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to:

the Minister for the Environment

the Minister for Agriculture

No. 2014/02E, The Hague, January 29, 2014

The Health Council of the Netherlands, established in 1902, is an independent scientific advisory body. Its remit is "to advise the government and Parliament on the current level of knowledge with respect to public health issues and health (services) research..." (Section 22, Health Act).

The Health Council receives most requests for advice from the Ministers of Health, Welfare & Sport, Infrastructure & the Environment, Social Affairs & Employment, Economic Affairs, and Education, Culture & Science. The Council can publish advisory reports on its own initiative. It usually does this in order to ask attention for developments or trends that are thought to be relevant to government policy.

Most Health Council reports are prepared by multidisciplinary committees of Dutch or, sometimes, foreign experts, appointed in a personal capacity. The reports are available to the public.

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Contents

Executive summary

Does the use of chemical plant protection products on agricultural land expose local residents to a risk of health impairment? This question has been examined by a committee of the Health Council of the Netherlands. Its findings are set out in this advisory report. Little research has been carried out in this area. There is some evidence, mainly from studies carried out abroad, that the use of such products can pose a health risk to local residents. Accordingly, the Committee feels that there is sufficient reason to initiate an exposure study among this section of the population here in the Netherlands, and to adapt the approval procedure for plant protection products. It also identifies measures that can reduce local residents' exposure.

The issue

There are various ways in which people can come into contact with chemical plant protection products (see Figures on Pages 74 and 75). One is by consuming fruit and vegetables grown using these products. Another involves the domestic use of such products in and around the home. Furthermore, those working in the agricultural sector are at risk of occupational exposure. Quantities of plant protection products carried in from nearby agricultural land constitute an additional source of exposure for local residents. During and shortly after the use of plant protection products, their concentrations in the vicinity of the application sites may temporarily increase. With the passage of time and at greater distances

from the source, however, these concentrations decrease rapidly as a result of dilution and breakdown.

Aside from the pests being targeted, plant protection products can be harmful to other species, including people. Partly for this reason, a comprehensive, statutory approval procedure was established. This is intended to ensure that risks to people and to the environment remain within accepted limits. The people in question are those who actually apply these products, those working with treated crops, bystanders and anyone passing by while application is taking place, as well as the consumers of treated food crops. Until recently, the procedure had placed little emphasis on any potential effects on the health of local residents. Some of those living in the vicinity of sprayed agricultural land are concerned. This applies in particular to crop cultivation sectors that make intensive use of these products, such as the flower bulb cultivation sector and the fruit growing sector.

In April 2011, both on his own behalf and on behalf of his counterpart at the then Ministry of Economic Affairs, Agriculture and Innovation, the Minister for the Environment asked the Health Council to prepare an advisory report on this issue. In an initial advisory memorandum, issued in September 2011, the Health Council replied that it would be useful to carry out an exposure study among such local residents in the Netherlands. In the present, more comprehensive advisory report, a committee of experts specially appointed for the purpose has conducted a closer examination of the risks to local residents. The issues of a suitable design for the exposure study and of possible measures to reduce exposure were also explored in greater detail.

Stakeholder hearing

Partly in response to a request from the above government officials, the Committee has involved stakeholders (local residents, environmental associations, the agricultural sector and industry) in the preparation of this advisory report. This approach was intended to ensure that the advisory report was as fully in keeping as possible with the needs of those affected by this issue. In January 2012, a hearing was held at which all of the stakeholders could air their concerns and make their information needs known. They also had the opportunity to contribute information which, in their view, was pertinent to the matter in question.

It emerged at this hearing that local residents are mainly concerned about the health of their children, and that they are worried about serious diseases such as cancer. Some believe that the current approval procedure is too heavily skewed

towards the risks to those whose occupations involve working with chemical plant protection products. They take the view that the risks to local residents have not been properly considered. Unlike those working with such products in a professional capacity, local residents are exposed involuntarily and for prolonged periods of time, nor do they wear any form of personal protective equipment. Another criticism is that no consideration has been given to exposure to combinations of plant protection products. Local residents feel that the authorities are not always receptive to their reports about health problems or about the incorrect use of such products. They feel that organisms in the surrounding ditches and watercourses enjoy greater protection than they themselves do.

Farmers and growers also consider themselves to be local residents. Together with manufacturers and distributors, they point out that much has been done to enable plant protection products to be used safely. They are constantly working to achieve further reductions in the emission of these products into the environment. In their view, the risks to local residents are minimal. Growers are more concerned about encroaching housing developments and the resultant restrictions on their business operations. Nevertheless, they are keen to engage in dialogue with local residents. They would prefer any methods for assessing the risk to local residents to be adopted and implemented at European level.

All of the stakeholders were in favour of conducting an independent study among local residents, with the aim of clarifying the risks involved.

Current plant protection policy

The Committee has determined that, for many years now, great efforts have been made to enable plant protection products to be used more safely and more sustainably. International cooperation has resulted in the establishment of a comprehensive and meticulous approval procedure. This is intended to guarantee that only effective products are admitted to the market, and that these products can be used in such a way that any risks to people and to the environment remain within accepted limits. Modern chemical plant protection products are more selective and more readily degradable than those used in the past. They are also much less likely to accumulate in the bodies of humans and animals.

However, any approval procedure is always a work in progress. The regulatory authorities are constantly seeking to make further improvements, based on new scientific knowledge and on the lessons learned from real-life experiences. Such improvements increasingly involve risks that are difficult to

assess, such as effects on the unborn child, exposure to combinations of products, and combined exposure from several different sources (work, food, environment).

The approval procedure is determined partly at European level and partly at national level. For instance, Europe determines which active ingredients may be used in plant protection products. The question of whether or not a given product may be used on their territory is a matter for the individual Member States to decide. The assessment methods used by countries in this connection are being increasingly harmonised.

As yet, the Dutch approval procedure does not include a separate assessment of the risks to local residents, with the exception of the risks to those living in the vicinity of greenhouses. In the Netherlands, the assessment of risks to bystanders and passers-by is limited to those whose occupation requires them to remain in the area while the product is being used. Existing models for assessing the exposure suffered by local residents, bystanders and passers-by still have a number of shortcomings. The European Food Safety Authority (EFSA) is currently working on effective, harmonised methods for assessing the risks to all local residents, bystanders and passers-by.

According to the Committee, however, this does not mean that all local residents, and casual non-occupational bystanders and passers-by in the Netherlands are currently completely unprotected. They benefit, to some extent, from the protection afforded to the other groups. Nevertheless, the Committee considers it possible that local residents, casual non-occupational bystanders and passers-by could suffer health effects, especially in situations in which a high degree of sensitivity and a high level of exposure are combined. This is the first of the Committee's arguments for advocating the use of an exposure study in this group.

The approval of a chemical plant protection product means that the product in question can be used to control crop diseases and pests both effectively and safely, provided that its instructions for use are carefully followed. A wide range of measures are in effect to ensure that this is actually carried out in practice. These involve legislation, regulations, mandatory proof of professional competence for those who make occupational use of such products, the mandatory inspection of spraying equipment, proper instruction, training and supervision. During a recent evaluation of plant protection policy, however, it was found that farmers and growers still do not assign sufficient priority to safety in the context of their business operations. Nor do they always comply fully with the relevant legislation and regulations. This is evident, for example, from the fact that various non-approved products are being used. This could have an

adverse impact on their own safety and on that of their employees and their families. In addition, it also increases the risks to local residents.

Exposure and health of farmers and growers

The question of whether, in practice, the use of chemical plant protection products results in exposure and health effects can be readily investigated in an occupational context. People who use these products and those working with treated crops generally experience the highest levels of exposure, especially if they fail to take adequate measures to limit their own exposure. In recent years, numerous epidemiological studies have been conducted among farmers and growers, both in the Netherlands and elsewhere. These regularly revealed associations between exposure to plant protection products and the occurrence of various health effects, such as reduced fertility, several forms of cancer (in their offspring as well) and disorders of the nervous system. The findings were particularly consistent for Parkinson's disease and for leukaemia in the children of farmers and growers. However, it is no simple matter to extrapolate the findings of studies carried out abroad to the Dutch situation. In addition, the results of studies performed here in the Netherlands are all rather dated. Since then, the range of approved products has shifted, more advanced spraying equipment has been developed, and more extensive instruction and training are available.

Why do farmers and growers still experience health effects when there is an approval procedure in place, together with numerous regulations governing the use of plant protection products that are intended to prevent this? Certain hazardous properties of these products may have been missed during the approval procedure, or the level of exposure involved have been misjudged. However, as farmers and growers tend not to give sufficient priority to safety, the Committee considers it likely that poor compliance with the regulations is a major cause of the health effects seen in this group. This is a second argument for exploring the exposure and health of local residents in greater detail.

Exposure and health of local residents

In the Netherlands, there have been very few studies into the exposure and health status of those living in the vicinity of agricultural land. On a very limited scale, measurements of air, soil, water and house dust have been made in and around homes. To the best of the Committee’s knowledge, no studies carried out in the

Netherlands have measured people's internal exposure to plant protection products, by analysing blood or urine samples from local residents, for example.

In other countries, especially the United States, more research has been carried out into the exposure suffered by local residents. These studies have demonstrated that local people can indeed be exposed to products emanating from their agricultural surroundings. The importance of any given exposure pathway seems to depend on the exact type of plant protection product involved and on how it is applied. With regard to less-volatile products, contaminated clothes and shoes appear to be a major pathway, in quantitative terms. This is supported by the fact that the members of farmers' and growers' households tend to suffer greater exposure than those in the households of people in other professions, living in the same area. There is some evidence for this in the Netherlands as well.

In agricultural areas of the Netherlands, local residents occasionally complain of nausea or of irritation affecting the skin, eyes or upper respiratory tract. Only very rarely is the possibility of a link to exposure to plant protection products investigated. A number of products are known to induce complaints like this, at sufficiently high levels of exposure.

Epidemiological studies of potential chronic health effects in local residents (again, most of these studies were performed abroad) provide some evidence that certain disorders may occur more frequently in this group. These include effects on the unborn child, childhood leukaemia and Parkinson's disease. However, these studies are few in number and much of the research involved has significant limitations. In particular, details concerning the level, sources and pathways of exposure are often very inaccurate. As a result, it is not possible to draw any conclusions about a causal relationship with environmental exposure. Nevertheless, the limited findings are in keeping with the effects seen in those who are exposed while making occupational use of such products.

Furthermore, studies carried out abroad have relatively little bearing on potential exposure levels and health effects here in the Netherlands. The exposure pathways are basically the same, but other countries can differ substantially from the Netherlands in terms of the absolute and relative importance of the individual pathways. This is related to differences in climate, landscaping and agricultural practice. In addition, many of the studies carried out abroad involved products that have never been approved in the Netherlands, or that are no longer approved here, or that were not approved in this country for the same pest in the same crop.

The Committee considers it possible that those disorders for which the epidemiological studies found some evidence also occur in the Netherlands.

However, it suspects that the risk to local residents will be low compared to the risk to those who are exposed while making occupational use of such products. Nevertheless, this evidence does constitute a third argument for closely examining the exposure of those living in the vicinity of agricultural areas of the Netherlands.

The usefulness of an exposure study in local residents

Given the observed health effects in farmers and growers themselves, coupled with some evidence of effects in local residents from studies performed abroad, and a lack of data from this country, the Committee feels that there is sufficient reason to conduct further research among local residents in agricultural areas of the Netherlands. The obvious starting point would be an exposure study. Based on the results obtained, an assessment could then be made of the potential usefulness of a study into health effects, and consideration could be given to the practical details involved. The best way to conduct an exposure study is to combine a range of different research methods. Biomonitoring (in this case, the measurement of plant protection products and their metabolites in the tissues or excretory products of local residents) can provide information about the total exposure from all sources and via all pathways. Measurements in contact media, such as air, soil, water, house dust, etc., in combination with additional data on exposure-determining factors (including the time and place at which products were used, dosages and application techniques, the habits and activities of local residents, dietary patterns, weather conditions) can provide some insight into the relative importance of sources and exposure pathways. Only such a fully comprehensive study can clarify the extent to which the agricultural use of plant protection products in the immediate vicinity contributes to total human exposure. This information is also needed to assess and, where necessary, improve the exposure models used in the approval procedure. It is also needed to evaluate the requirement for, and effectiveness of, exposure reduction measures by national and local governments, farmers, growers, and local residents themselves.

The Committee recommends that the exposure study should focus on farmers and growers, their families, and those working in other professions. There should be a special focus on women of childbearing age (with a view to the unborn child) and very young children. Young children in particular are especially sensitive. Due to their behaviour and build, they may suffer higher levels of exposure than adults. Modern plant protection products degrade very rapidly and there is a substantial temporal variation in exposure. This means that intensive

sampling and research over a period of several years is required. Both a knowledge of suitable biomarkers (measurable parent compounds or metabolites in human tissues and excretory products) and the availability of analytical methods are indispensable in this regard and will have to be developed where necessary. The Committee expects that the above-mentioned research will involve a budget of several million euros.

Follow-up research into health effects can be useful if the exposure levels of one or more plant protection products are found to be close to, or above, health-based limit values. In such cases, it makes good sense to take additional measures (further to those being advocated here by the Committee) to reduce exposure, rather than waiting for the results of long-term epidemiological studies into health effects.

The Committee takes the view that effective communication with stakeholders before, during and after the study – concerning its purpose, design and outcome (or potential outcome) – is crucial. It should be clearly explained to participants, in advance, that it is not the presence of plant protection products, as such, that determines whether there are risks to health. The really important factors in this regard are the levels and duration of exposure. The Committee takes the view that, in due course, a medical ethics committee should be consulted about the study's design.

Given the on-going changes in plant protection practice, the Committee also recommends that consideration be given to more routine monitoring of external and internal human exposure to plant protection products. This would provide valuable information on the effectiveness of current plant protection policy. The proposed study of local residents could provide valuable lessons for continuous monitoring of this kind, while at the same time constituting a first step in this direction.

Measures to reduce local residents' exposure

It will be several years before the exposure study proposed by the Committee can provide greater clarity about the extent to which those living in the vicinity of agricultural land (including farmers and growers, and their families) are exposed to chemical plant protection products, and about any risks that this might entail. This does not mean that measures cannot already be taken to reduce the exposure suffered by local residents. The Committee considers it important that the concerns of local residents be taken seriously, as anxiety also diminishes people's quality of life. The measures in question relate to the approval procedure and to agricultural practice.

Approval procedure

Within the framework of the EFSA, the government can work to further improve the approval procedure in general, and to add a separate risk assessment for local residents in particular. This is necessary, according to the Committee, because local residents constitute a clearly distinct high-risk group, at least as far as the risks of prolonged exposure to lower concentrations are concerned. Any risks to local residents arising from short-term peak exposure are already taken into account by the current risk assessment for non-casual occupational bystanders and passers-by. However, this will have to be expanded to cover all bystanders and passers-by (including children). Until such time as the EFSA method is ready for use, the Netherlands can use the current German and British methods. The Committee recommends that random sampling be used to establish whether there is a genuine need to submit every product that has already been approved to an additional assessment, to determine whether they pose any risk to local residents and to casual non-occupational bystanders and passers-by. Meanwhile, the Netherlands is already using a national methodology to assess the risks to those living in the vicinity of greenhouses. The Committee considers it advisable that this method be documented in such a way that it can be readily incorporated into the EFSA method. Failing that, it recommends that an alternative approach be adopted to achieve the harmonisation of this assessment at European level.

The Committee also recommends that the Netherlands should launch a further debate, within the EU, about whether the approval dossier provides adequate guarantees concerning the details of a product's kinetics (the fate of a substance) in the human body. This information is essential to the development of a biomonitoring equivalent (health-based limit value in urine, for example) for the plant protection product in question. In addition, details of the methods used to analyse human blood and urine should be a standard feature of the approval dossier submitted by manufacturers. To date, however, this has not always been the case.

Finally, the Committee feels that it would be useful if the Board for the Authorisation of Plant Protection Products and Biocides (Ctgb) were to launch better public information campaigns about the approval procedure.

Agricultural practice

In agricultural practice, this mainly involves measures to reduce the use of chemical products and to cut any associated emissions to the environment. Either directly or indirectly these measures will help to reduce the exposure suffered by

local residents. It is precisely because of these wider benefits that they have already been partly implemented by stakeholders or have been incorporated into the planned plant protection policy for the coming years (see Second Policy Document on Sustainable Plant Protection). The interests of local residents are an additional argument in favour of the prompt implementation of these measures.

The main measures that the national government or local government need to implement are:

- promoting integrated plant protection
- improving the current complaints structure for members of the public who have complaints or questions about the use of plant protection products in their immediate area
- enhancing compliance by means of inspections
- establishing no-spray zones.

The agricultural sectors can:

- put more effort into ensuring the safety of their own members and that of local residents; in the training programme leading to a certificate of professional competence (spraying licence), more consideration could be given to safety aspects (including the safety of local residents)
- perform more exposure tests during periodic medical examinations (PMO)
- communicate more effectively and more actively with local residents concerning the use of plant protection products
- continue to develop technical solutions to cut product use and to reduce spray drift.

Manufacturers and distributors can:

- also target their information provision and product innovation on reducing the risks to local residents.

Local residents themselves can:

- discuss their concerns and wishes with the farmer or grower in question
- use the complaints structures provided by local and national governments to report concerns or incidents
- take steps to reduce their own exposure. For instance, they could close the windows and avoid sitting in the garden while an adjacent plot of land is being sprayed (and shortly thereafter). They could also wash any food grown in their own garden prior to consumption.

Chapter 1

Introduction

1.1 Background

In the year 2000, the Health Council issued an advisory report on the atmospheric dispersion of chemical plant protection products.[1] That advisory report was partly based on the results of an international workshop held by the Council.[2] It focused on the ecological significance of the airborne dispersion of these substances from agricultural land to the natural environment. The advisory report and the accompanying workshop report made it clear that airborne plant protection products can be carried away from treated land, during and after application. The extent to which this occurs depends on a large number of factors, such as the method of application, the properties of the substance in question, and the weather conditions. The fraction that ultimately becomes airborne can, therefore, vary greatly. In the Netherlands, however, this averages about ten percent of the total amount applied.[3] Once airborne, plant protection products can travel considerable distances (kilometres). While plant protection products are being used, and shortly thereafter, their concentrations in the vicinity of the application sites may temporarily increase. With the passage of time and at greater distances from the source, these concentrations decrease rapidly as a result of dilution, breakdown, and precipitation.

People in general, and those living in the vicinity of treated agricultural land in particular, may come into contact with chemical plant protection products. The Netherlands is a densely populated country, with a great deal of intensive

agriculture and horticulture. Accordingly, depending on the region in question, this can involve relatively large numbers of people. These products are designed to kill pathogens and pests, but they can also be harmful to other organisms, including humans. Partly for this reason, plant protection products are only admitted to the market after they have completed a statutory approval procedure.[4] This includes checks to establish whether their use, as proposed by the manufacturer, can take place 'safely'. Potential risks both to the environment and to humans are assessed. The health risks to anyone who may come into contact with these products through their work, their food or their environment must remain within accepted limits. For a long time, however, the government has not specifically focused on any potential effects on the health of local residents. The prevailing view was presumably that there can be no appreciable risk to those living in the vicinity of treated land if the approval procedure keeps the health risks to operators (who suffer higher levels of exposure) within acceptable limits. Nevertheless, those living in the vicinity of sprayed agricultural land in the Netherlands and elsewhere are concerned about their own health and that of their children.[5,6] This applies in particular to plant cultivation sectors that make intensive use of these products, such as the flower bulb cultivation sector and the fruit growing sector.

1.2 The request for advice

On 18 April 2011, both on his own behalf and on behalf of his counterpart at the then Ministry of Economic Affairs, Agriculture and Innovation, the Minister for the Environment asked the Health Council to prepare an advisory report on possible health risks (resulting from the application of plant protection products) to those living in the vicinity of agricultural land. In his letter (see Annex A), the Minister posed a number of questions. Firstly, he wanted to know whether local residents may be exposed to such an extent that their health might be at risk. He asked for special consideration to be given to vulnerable groups, situations involving high exposure, exposure to combinations of substances, those living in the vicinity of greenhouses, and exposure through contaminated vegetable gardens. He also wanted to know whether a planned European modification to the risk assessment methodology used in the approval procedure for plant protection products will cover the risks to local residents. Finally, he asked the Council's opinion concerning the usefulness and design of a 'screening programme' to identify the health risks to local residents. In view of recent public concern on the subject, the Minister asked that local residents be included in the preparation of the advisory report. He indicated that he wanted an answer

to his question about the screening programme in advance of the rest of the advisory report.

1.3 Advisory letter

In accordance with the Minister 's request and after consulting the members of the Ad Hoc Committee (which had not yet been officially appointed) and the Standing Committee on Health and Environment, the Vice President of the Health Council, Prof. H. Obertop, issued an advisory letter on 2 September 2011, in which he answered the former's question about the usefulness and design of a screening programme.[7] In the advisory letter, the Vice President expressed the view that a study conducted among local residents would certainly be useful. Initially, this would involve a study into the exposure of local residents to plant protection products. This is because relevant monitoring data is virtually non-existent. Existing data from other countries cannot be directly translated to the Dutch situation. Without knowledge of the exposure involved, it is impossible to make any statements at a later stage about possible health effects. The Vice President announced that, in the planned advisory report, the Council would further explore the issue of a suitable design for the exposure study, as well as answering the other requests for advice. The full text of the advisory letter is set out in Annex C.

1.4 Committee and procedure

On Monday 31 October 2011, the Vice President of the Council installed the Committee on 'Crop Protection and Local Residents'. In doing so he has, as usual, ensured that it is multidisciplinary in nature and that it has a well-balanced composition. The former means that the Committee's members will include experts from a range of relevant fields. The latter indicates that the Vice President deliberately appointed to the Committee experts with divergent views on the issue to be examined. All members and consultants have completed a public declaration of interest form. Details of the make-up of the Committee are given in Annex B. In the advisory report, 'the Committee' is taken to mean 'the Committee on Crop Protection and Local Residents', unless specifically stated otherwise.

1.4.1 *Objective, mission statement and scope*

The primary purpose of the Committee is to answer the Ministers' questions. In essence, these require that an investigation be carried out to determine the extent to which those living in the vicinity of agricultural land on which plant protection operations are taking place are exposed to plant protection products. Another point to be investigated is how the contribution from agricultural land in the immediate vicinity compares to that from other sources (such as food). The final point is whether that contribution substantially increases the risk of health impairment or whether it can be reliably linked to health problems.

In this advisory report, the Committee has restricted itself to exposure to chemical plant protection products that are used for agricultural purposes. The application of chemical products in areas outside agriculture, such as their use by local authorities to remove weeds from pavements, has been given no further consideration in this report. This also applies to the products used in biological pest control. With regard to chemical products, this advisory report does not confine itself solely to products that are sprayed, but also to products that are applied in other ways, such as injection into the soil, spreading as granulates, or fogging. For the sake of convenience, the Committee occasionally uses the terms 'sprayed' areas of land or 'sprayed' fruit and vegetables, without wishing to exclude other methods of application.

A similar 'local residents issue' involves the application of some biocides, especially gaseous disinfectants or disinfectants that release gases (formaldehyde, chlorine), like those used for the disinfection of animal pens and mushroom beds. The Committee is simply calling attention to this issue and does not explore it any further in the advisory report. Nevertheless, from time to time, it cannot escape the need to comment on biocides, medicinal products, veterinary products, and cosmetics, where these products include the same (or similar) active ingredients. The focus is the exposure suffered by, and possible effects on, those living in the vicinity of treated land. Here too, it sometimes is necessary to consider the exposure suffered by occupational or private operators and by those who consume sprayed fruit and vegetables. These may indeed be the same individuals. The Committee focuses on all types of plant cultivation within the agricultural sector.

Furthermore, the Committee has limited its deliberations to the health-related aspects of this issue. It is cognisant of the fact that this issue has ecological, agricultural, and economic ramifications that are important in terms of decision making. One of the Council's previous advisory reports has already shed light on

the first of these.[1] Any policymakers and stakeholders requiring details of the issue's remaining ramifications should consult other expert bodies.

1.4.2 *Terminology*

In Annex I, the Committee presents a comprehensive glossary. There, it explains technical terms, and gives details of what it means by commonly used concepts such as 'risk', 'hazard', 'harm' and 'safety'. The Committee explains the most important (for the purposes of this advisory report) terms below.

Plant protection products – pesticides – agrotoxins

When examining the scientific literature in this area and press reports, the Committee found that different stakeholders use different terms for the same chemical products. These different terms reflect the divergent perspectives of the various stakeholders. Farmers and manufacturers see these products as a useful means of protecting valuable crops, in which a great deal of money and effort have been invested. In their view, these products are fully comparable with veterinary medicines and human medicinal products against fleas, lice, worms or fungi in pets and humans. To some extent, these products also contain the same or similar substances. Local residents, on the other hand, see them as poisons designed to kill: toxins carried away from farmers' fields on the wind, that threaten their own health and that of their families.

The Committee has no clear preference concerning these terms or the associated perspectives. In the Committee's view, it is quite understandable and entirely legitimate for people experiencing differing interactions with chemical products of this kind to hold differing perspectives and to use different terms. Nevertheless, purely for the sake of clarity and consistency, the Committee will use the same term, in each case, throughout this advisory report. It has adopted the term used in relevant legislation[4], which is why 'plant protection products' is also used in the request for advice. The Committee is at pains to point out, however, that by opting for certain terms it in no way wishes to undermine the validity of the other terms and perspectives.

The Plant Protection Products and Biocides Act[4] describes a plant protection product as:

> an active ingredient or a preparation containing one or more active substances to be used in order to: 1) protect plants or plant products from all harmful organisms or prevent such organisms from inflicting harm; 2) influence the living processes of plants, but without involving any nutrients; 3)

store vegetable products; 4) kill unwanted plants or 5) destroy parts of plants or prevent or inhibit the unwanted growth of plants.

Plant protection products come in a variety of forms (solutions, powders, granules or gases). This is related to the method of application. In addition to one or more active ingredients, plant protection products often contain one or more adjuvants, such as solvents, sticking agents, wetting agents, et cetera.

Local residents

In a document recently issued by the European Food Safety Authority (EFSA) local residents are defined as:[8]

"Persons who live, work or attend school or any another institution adjacent to an area that is or has been treated with a plant protection product (PPP); whose presence is quite incidental and unrelated to work involving PPPs but whose position might lead them to be exposed; who take no action to avoid or control exposure; and who might be in the location for 24 hours per day."

The Committee endorses this definition, with the caveat that it firmly includes farmers and growers themselves, and their families, in the category of 'local residents', inasmuch as they live near treated land. These farmers and growers' exposure in the living environment is compounded by their occupational exposure.

The European Food Safety Authority (EFSA) document in question gives no further definition of what is meant by 'adjacent to'. Researchers in an ongoing UK study define this as up to a maximum distance of 100 metres.[9] The Committee sees this as a sound and pragmatic provisional choice. That limit can be modified at a later point in time, if research results show this to be appropriate.

1.4.3 The Committee's procedures

Literature review

The Committee derived answers to the questions posed in the course of its deliberations on the current level of knowledge. They obtained an impression of the latter by studying the relevant literature. This primarily involved the international scientific literature. There is a wealth of publications on the possible health effects of plant protection products. Many of these articles

describe the results of toxicological studies with experimental animals, or in-vitro studies of cells (including human cells). Numerous epidemiological studies have also been carried out. This mainly involves research into the health effects associated with occupational exposure (at relatively high levels). Another group of publications focuses on the health effects in private individuals caused by pest control in or around their homes. All of this literature is at best indirectly relevant to an assessment of the health risks to those living in the vicinity of agricultural land.

Relatively few epidemiological studies have been carried out into the possible health effects of agricultural plant protection in those living in the vicinity of agricultural land, horticultural land or greenhouses. The Committee searched PubMed (a database accessing references and abstracts on life sciences and biomedical topics) for publications on this topic, using the search profile "pesticides AND (residential proximity)". It supplemented the articles found in this way with publications cited in these articles, and with literature supplied by third parties. The Committee did not attempt a fully comprehensive review. After all, the results of studies carried out abroad can shed no light on the extent to which local residents in the Netherlands are exposed to plant protection products. Accordingly, they cannot be used to determine any associated increased risk of health impairment.

Two of the Committee's main goals were to find evidence of exposure of those living in the vicinity of agricultural land to plant protection products and of any ensuing health effects. The third was to understand the circumstances that bring this about. This approach makes it possible to assess the usefulness or desirability of carrying out a study here in the Netherlands.

The Committee mainly used review articles to obtain details of the exposure suffered by farmers and growers, and information about their health. The Committee also used original articles to obtain details of the exposure and health of local residents. In particular, the Committee limited itself to studies carried out in Western countries. Agricultural practices and plant protection practice in these countries is more in keeping with the situation in the Netherlands.

In addition to scientific articles, it also consulted relevant reports produced by prominent research institutes in the Netherlands and elsewhere, and by various international bodies. The Committee was firmly committed to the task of unearthing the scientific facts of the matter, while also identifying areas in which there are knowledge gaps and uncertainties. It has not carried out any laboratory research or field studies of its own, nor has it made any measurements.

Visit to researchers in the UK

An ongoing study in the United Kingdom is currently investigating the exposure to plant protection products suffered by those living in the vicinity of agricultural land.[9] On 5 October 2012, the Scientific Secretary and a member of the Committee visited the Institute of Occupational Medicine in Edinburgh, which is coordinating this study. The purpose of the visit was to benefit from the lessons learned by the British researchers involved in this study.

Exposure calculations

In 2010, the European Food Safety Authority issued a 'scientific opinion' on the methods used to assess the risks to operators of using plant protection products, to workers handling treated crops, and to bystanders or casual passers-by.[8] The article includes a preliminary step towards a method that can also be used to estimate the exposure suffered by those living in the vicinity of agricultural land. The Committee has used this approach in an attempt to calculate local residents' exposure to four plant protection products used in lily cultivation, and the resulting risks.

Contact with stakeholders

Members of the government increasingly tend to decide their course of action in (or following) consultation with stakeholders, whom – they resolutely insist – must assume responsibility. The same most certainly holds true with regard to policy on plant protection products. The Committee wants its advisory report to inform and facilitate that decision-making process as effectively as possible. With this in mind, it has attempted to discuss complex issues in a way that is intelligible to all those involved. It wants to satisfy the information needs of all of the stakeholders while taking note of their diverse perspectives and making effective use of their practical experience. Accordingly, the Committee has not only complied with the Ministers' request that local residents be involved in the preparation of the advisory report, it has also approached other stakeholders, namely representatives of the agricultural sector and the agrochemical industry. Prior to the preparation of the advisory report, the Committee held a hearing to this end, for invited guests, on the evening of 30 January 2012, in the Jaarbeurs conference centre in Utrecht. The names of all participating stakeholders and references to their individual contributions (in Dutch) are listed in Annex D.

On 30 July 2013, the Committee published the draft text of its advisory report and invited comments from interested parties. On 7 October 2013, it held another hearing for invited guests. The purpose of the published draft report and the second hearing was to check whether the Committee had phrased its advisory report in intelligible terms, whether stakeholders' information needs had been met, and whether the available practical knowledge had been sufficiently utilised. The Committee incorporated the information obtained into the definitive advisory report as it saw fit. Details of those who submitted comments on the draft advisory report and of those who participated in the second hearing are listed in Annex E, as is the Committee's response to these comments.

Review

The modified draft advisory report was submitted to the Health Council's Standing Committee on Health and the Environment for review. Several outside experts have also been asked to comment on the draft text. In addition, the Committee consulted experts about various sub-topics. Their names are listed in Annex F. Here too, the Committee incorporated this information into the final text as it saw fit.

1.5 Structure of the advisory report

In the next chapter, the Committee examines the concerns of local residents in greater detail. After a brief historical summary, it discusses the contributions made by local residents at the hearing held before the advisory report was drawn up. The perspectives of other stakeholders are also discussed.

Chemical plant protection in the Netherlands is the subject of Chapter 3. The emphasis is on existing policy measures (or those that are currently in preparation) to ensure that the use of chemical plant protection products is not only effective but also safe. The first of these relates to the approval procedure for these products. Others concern measures to steer their use in the everyday situation in the right direction, and policies aimed at sustainable plant protection.

The question of whether this policy is sufficiently effective can primarily be decided by the results of studies into the exposure and health of those who come into occupational contact with chemical plant protection products: both operators working with these products and workers handling treated crops. This is addressed in Chapter 4.

The policy's effectiveness can also be determined from studies into the exposure and health of local residents. The results of these studies are the focus of Chapter 5.

In Chapters 6 and 7, the Committee discusses potential policy measures aimed at further clarifying the risks to local residents or at cutting their exposure. Chapter 6 is entirely devoted to an examination of studies conducted among local residents in the Netherlands, in terms of what they can and cannot be expected to deliver. It also addresses the various goals and different designs of such studies. In Chapter 7, the Committee discusses possible changes to the approval procedure and measures in agricultural practice to limit the exposure of local residents.

In Chapter 8, the Committee answers all of the Ministers' questions.

Chapter 2

Concerns of and about local residents

In this chapter, the Committee gives outline details of how society has struggled, for many years now, with the question of how much the health of those living in the vicinity of agricultural holdings is impaired by the use of chemical plant protection products. The Committee also discusses the results of the hearing that it held before the advisory report was drafted. This hearing was intended for local residents, environmental groups, the agricultural sector, and for the manufacturers and distributors of plant protection products.

2.1 Historical summary

The potential adverse effects on human health, and on the quality of the environment in general, associated with the use of plant protection products have been clear-cut issues for at least fifty years.[10,11] However, specific concerns about the health of people living in the vicinity of the fields, orchards and greenhouses where these products are used date from the 1980s, in the Netherlands at least.

2.1.1 Greenhouse horticulture

Concerns about the exposure of local residents to plant protection products originated around 1980, in the region of Westland. The use of methyl bromide (a volatile substance) to fumigate greenhouses resulted in the contamination of tap

water and in concentrations in outdoor air that were considered to be higher than advisable.[12,13] It was at around the same time that people first began to suspect that the area had an above average number of miscarriages, stillbirths and congenital abnormalities. It was suggested that this might be linked to the use of methyl bromide. However, an exploratory study was unable to confirm that there was an increased incidence of the phenomena in question.[14] Nevertheless, a provisional ban imposed on the use of this fumigant was extended indefinitely. Waivers were only granted for greenhouses sited at least 80 metres from the nearest house and 250 metres from sensitive zones (such as schools and retirement homes). In addition, no fumigation work was permitted under stable weather conditions. In 1992, this was followed by a total ban on the use of methyl bromide as a soil fumigant in the Netherlands.[15]

At around the same time (possibly triggered by the lessons learned with methyl bromide) concerns arose about the exposure to other plant protection products suffered by those living in the vicinity of greenhouses. In 1985, in the horticultural community of Aalsmeer, the parents of a boy who had died of leukaemia drew attention to the fact there were 12 others with a 'similar' disease within a radius of one kilometre.[16] They wondered whether this might be related to frequent swimming in a natural pool, which they suspected (quite rightly, as it later turned out) was contaminated with plant protection products. A study carried out by the municipal health service from 1980 to 1985 showed that, in Aalsmeer, leukaemia and lymphoma in young people were four times more common than would be expected.

In 1996, legal requirements concerning the distance between homes and greenhouses came into effect.[17,18] The following distances applied to new agricultural holdings: 50 metres to a row of houses or a sensitive building (no clear definition was given, but the Committee suspects that this included schools) and 25 metres to a detached property owned by parties other than the farmer/grower in question. For existing greenhouses, the distances were 25 metres and 10 metres respectively. The measure was founded on model-based calculations carried out by the Netherlands Organisation for Applied Scientific Research (TNO) and the National Institute for Public Health and the Environment (RIVM).[17] In cases where these separation distance requirement were not met, a permit procedure had to determine whether any adverse effects caused by the agricultural holding in question could be prevented by other measures. In 1999, the Zuid-Holland Environmental Federation won a test case against a municipality that it felt had deviated from the separation distance requirements without supplying sufficient reason for so doing (Administrative Law Council of State (ABRvS), 23 July 1999, No. E03.95.1762). Since 2013, all of the

environmental rules for the greenhouse horticulture sector have been included in the Environmental Activities Decree. However, these no longer include any requirements regarding the distance between homes and greenhouses. The underlying concept is that this can be better regulated by means of spatial policy (municipal zoning). The question of exactly what distances are appropriate in the context of spatial considerations will, in future, be left to those working in everyday practice (and, to some extent, jurisprudence) (http://www.infomil.nl/onderwerpen/landbouw-tuinbouw/activiteitenbesluit/sectoren/glastuinbouw-0, accessed 27 February 2013).

2.1.2 *Orchards / tree nurseries*

In the past, those living in the vicinity of orchards and tree nurseries occasionally expressed concern about their exposure to plant protection products (e.g. in the Buren local authority, see ABRvS 18 April 2012, Case 201006290/1/R2). This concern is linked to the relatively high usage levels of these products in the fruit-growing sector, and especially with sideways or upward spraying. Unlike covered cultivation, legal separation distance requirements from homes have never been formulated for open field cultivation (although this has been done for watercourses). Since the mid-1990s, spatial planning concerning the siting of orchards and homes relative to each other has been regulated by municipal zoning. Based on legal judgments, the preferred distances between traditional orchards and individual homes or sensitive zones (or the associated gardens) are 50 metres for the former and 100 metres for the latter (ABRvS 25 April 2012, 201012191/1/R3; ABRvS 2 June 2004, 200305192/1). This is founded on model-based calculations carried out by TNO.[19] The distances cited are indicative. The governing bodies involved must consider whether there are any special circumstances that might warrant approving a separation distance other than those cited above. The effect of this approach is that fruit growers are concerned about encroaching development, such as new housing estates on the edges of towns. They are apprehensive about a future in which concerned local residents, and no-spray zones or cultivation-free zones might restrict their business operations (Eersel: ABRvS 25 April 2012, 201012191/1/R3; Vleuterweide: ABRvS 2 June 2004, 200305192/1).

2.1.3 *Potato cultivation*

In the north of the country, people were concerned about the use of plant protection products in potato cultivation. This involved the use of volatile soil

fumigants, in particular dichloropropene and metam sodium. As long ago as 1976, the Groningen Environmental Studies Centre (which later became the Center for Energy and Environmental Sciences) found concentrations of dichloropropene in the outside air that were close to health-based standards.[20] Drinking water in the province of Drenthe was found to be contaminated with dichloropropane, an impurity found in dichloropropene.[21] In the late 1980s, at the request of the Drenthe Environmental Council, the University of Groningen's Chemistry Science Shop and Public Health Science Shop examined the issue of whether the high usage levels of soil fumigants in potato cultivation in the provinces of Groningen and Drenthe might entail risks to the health of local residents. In the resulting report[22,23], the researchers concluded (based on model-based calculations) that the risk of exposure via the air was greater than the risk of exposure via drinking water. The report's authors felt that the results indicated a need for measurements, with the emphasis being given to peak exposures. The report made no mention of any specific concerns expressed by the local residents themselves, or of any complaints that they might have had. Concerns on the part of the government and of product approval holders, regarding concentrations in the air in the vicinity of fumigated land prompted a comprehensive measurement campaign in the north-eastern region of the Netherlands from 1985 to 1988. One the Committee's consultants, Dr F. van den Berg, was involved in this campaign as a researcher. The measured values were found to be within safe limits. However, short-term exposures under adverse weather conditions had only a limited safety margin.[24] Since then, dichloropropene has been banned, and land can now only be fumigated with metam sodium once every five years.

2.1.4 *Flower bulb cultivation*

In 1982, at the request of employees in the flower bulb cultivation sector, Leiden University's Science Shop launched an investigation into the risks of working with plant protection products in that sector, in the province of Zuid-Holland.[25] This request was based on the fact that very intensive use is made of these products in the flower bulb cultivation sector. Consultation within the university led to the study question being split into two main questions. One question was about the risks to farmers and workers in the work situation, and the other about the risks to the population in general, through environmental exposure. The latter study was undertaken by the Institute of Environmental Sciences in Leiden. Soon afterwards, a desk study was carried out into the risks of plant protection product emission from foliage burning in the flower bulb cultivation sector.[26] The Committee found no evidence in either report that the study was prompted by the

concerns of local residents themselves. The prime movers may have been the scientists involved, motivated by the conviction that research was also needed into the risks posed to the general population.

A short time later, a follow-up investigation was launched into the health risks to young children in the flower bulb-growing region. The resulting report does mention concern among residents of the flower bulb-growing region.[27] Accordingly, a 'Flower-Bulb-Growing Region Environmental Group' was already in existence.

During the 1990s, in response to concerns about the effects of long-term exposure to plant protection products, several municipal health services in the provinces of Noord-Holland and Zuid-Holland carried out literature reviews and preliminary model-based calculations of the health risks to those living in the vicinity of flower bulb fields.[28] It was concluded that exposure to individual products was unlikely to cause health effects, but that effects resulting from exposure to combinations of substances could not be ruled out.

In a 1998 study by the municipal health service in the Kop van Noord-Holland region, 52 percent of the population indicated that they live either in an agricultural area or a flower bulb cultivation area.[29] It emerged that over three percent were concerned or seriously concerned about this. In local authority areas characterised as agricultural areas or flower bulb-growing areas by 75 percent or more of the population, 6 to 12 percent of people were concerned. The latter percentage was not from the local authority area with the highest level of flower bulb cultivation, but from one with an active local residents' group opposed to environmental pollution caused by the flower bulb cultivation sector (Zijpe).

In 1998, the 'Keep Zijpe Liveable' association was founded at Zijpe, in the province of Noord-Holland (see www.hzl.nl). This association was worried about the impact of plant protection product use on the health of residents in the local authority area. A literature study on the relationship between the use of these products and respiratory complaints showed that too little information was available about the exposure of local residents for potential health risks to be estimated accurately.[30] The association therefore asked Utrecht University's Biology Science Shop to further investigate the exposure in question. The ensuing study showed that plant protection products were present in house dust. While this mainly applied to the homes of those who were employed in the agricultural sector, to a lesser extent it was also true of other houses in the area.[31,32] The concern in Zijpe led the Netherlands Organisation for Applied Scientific Research (TNO) to undertake exploratory model-based calculations.[33] Based on the results, the then Minister for the Environment reported to the

Dutch House of Representatives that no adverse health effects were to be expected and that additional research would probably not lead to a different conclusion.[34] The association then shifted its focus to other aspects of the environment.

During the 1980s, there was a gradual expansion of the flower bulb cultivation sector in the northeast of the Netherlands. Commissioned by the *Stichting Friese Milieuraad* (Frisian Environmental Council Foundation) the University of Groningen's Chemistry Science Shop investigated the associated environmental impact.[35] At that time, people focused mainly on how the landscape and the natural environment might be affected. In 2002, the Drenthe Nature and Environment Federation issued a memorandum entitled *Land van de reizende bol* ('Land of the Travelling Bulb') about lily cultivation in that province.[36] At around the same time, a group of concerned citizens examined the environmental aspects of lily cultivation. This group eventually developed into *Stichting Bollenboos* ('the Bollenboos Foundation'). Ever since, they have been calling attention to the effects of flower bulb cultivation (especially the cultivation of lily bulbs in Drenthe) on the landscape, the environment and the health of local residents (see www.bollenboos.nl).

The Heerenveen local authority attempted to prohibit the rotation of bulb crops within a zone of 30 metres of land with a residential zoning plan, but this was blocked by the Council of State (ABRvS 13 May 2009, case 200801516/1). One major consideration for this court was the downward spraying method used in the flower bulb cultivation sector. Another was a report by one of the current Committee members, Prof. D.J.J. Heederik, in which (based on an analysis of the scientific literature) he expressed the view that the use of plant protection products posed only a small risk to local residents.[37] In 2011, the Bollenboos Foundation expressed its concerns in Zembla, a Dutch TV current affairs programme. In that programme, Prof. M. van den Berg and Prof. P. Sauer (who are now members of the Committee), stated that a lack of monitoring data on the exposure involved makes it difficult to assess the risks to local residents.

An inventory of discomfort, concern, and residential satisfaction in the Netherlands drawn up by the National Institute for Public Health and the Environment (RIVM) showed that the proportion of people in an 'agricultural area or flower bulb cultivation area' who are concerned or seriously concerned about their own safety increased from 11 percent in 1998 to 18 percent in 2008.[38]

2.1.5 *In other countries*

Similar concerns exist among members of the public in the United Kingdom (http://www.pesticidescampaign.co.uk). In 2005, the Royal Commission on Environmental Pollution released a critical report on the exposure to plant protection products suffered by those living in the vicinity of agricultural land.[39] The report was attacked by other British government bodies.[40,41, see also 42] Nevertheless, it propelled Britain into a European leadership role in this field and prompted the Health Council to incorporate this theme into its work programme.

In Germany, too, the public are sometimes concerned about the use of plant protection products in their surroundings. Two examples are tree nurseries in Schleswig-Holstein[43] and in the Sauerland (*Bürgerinitiative giftfreies Sauerland*, http://www.giftfreies-sauerland.de).

Over the past ten years, environmental groups in the US have produced several reports on the concentrations of plant protection products in the outdoor air close to homes and schools.[44-46] They argue that the vaporisation of plant protection products during and after application leads to the involuntary exposure of people in the vicinity. They also assert that, from a health-based perspective, reference values that are deemed safe are frequently exceeded.

2.2 Hearing

On 30 January 2012, the Committee held a hearing with all the stakeholders. Six groups of local residents, four agricultural and horticultural umbrella organisations, plus the industry associations of traders in plant protection products and of the agrochemical industry each gave ten-minute presentations. This was an opportunity to indicate what information (or what sources of information) they considered important for the newly launched committee, to state their concerns about the topic, to outline their envisaged solutions, and to identify the issues they felt the advisory report needed to address. In the interests of openness, all of those invited were permitted to attend the lectures delivered by the other stakeholders, as observers. They were not offered the opportunity to engage in discussion. Of those present, only members of the Committee were permitted to ask questions, for the purpose of clarification. They made extensive use of this opportunity. In this Section, the Committee summarises the results of the hearing. The names of all participating stakeholders, together with references to their complete presentations (in Dutch) on the Council's website, are given in Annex D.

In the months following the hearing, several participants handed in additional information. Indeed, the Committee had specifically requested this during the hearing. It did so again, by letter, in the summer of 2012, stating that any additional information was still very welcome. These details have also been included below.

2.2.1 *The perspective of local residents and environmental organisations*

The use of plant protection products for flower bulb cultivation raises concerns among those living in the vicinity, with regard to their health and to the environment. They point to the high usage levels (in kg of active ingredient per hectare per year) in this form of cultivation and to the large number of cultivated fields in some regions. Yet those who live in the vicinity of land used for fruit growing and osier (wicker) cultivation also say that they are concerned. Their concerns arise from the realisation that part of the total amount of plant protection product used becomes airborne during and after application. In this context, they make reference to Dutch measurements showing that plant protection products are present in air and rainwater. For some local residents, the lack of standards for plant protection products in air and rainwater is a shortcoming. In homes situated near flower bulb fields, plant protection products have also been found in house dust. In surface waters, some products exceed existing ecological standards. Local residents wonder whether it is safe to eat vegetables and herbs grown in their own gardens, or whether it is safe to water the garden using ground-water from their own private wells or ditch-water. They point to research commissioned by Greenpeace and carried out by Prof. P. Sauer (a member of the Committee), which shows that, after a certain period of time almost any new substance introduced into society will be found in the human body.[47,48]

Local residents claim that their appeals to local and regional authorities have largely fallen on deaf ears, as the products in question have been approved. They suspect, however, that the issue of whether or not a product should be approved is mainly assessed in the context of business and work. They contend that there is an asymmetry between themselves on the one hand and farmers and growers on the other. This is an issue that, in their view, merits greater attention. After all, growers and agricultural contractors have protective clothing and gloves, and sit in enclosed tractor cabs. They also have an adequate knowledge of the products being used, and an awareness of how to behave. Local residents do not have these advantages. Moreover, after applying the plant protection products, operators leave the area, while those living in the vicinity of the treated land

remain behind. Even when only small amounts are involved, local residents feel that they are being exposed 24 hours a day, 7 days a week, year in year out, without any protection whatsoever. They cannot comprehend how it is permissible to market products that have not been tested for the risks of unprotected, chronic, involuntary exposure. Also, throughout the growing season, various plant protection products are used either simultaneously or in rapid succession. The residents contend that nothing is known about the potential effects of this cocktail of products.

The greatest source of concern for local residents is the health of their children, especially unborn children and very young children. Local residents claim that some flower bulb fields are situated right next to crèches and schools. These are attended by children as young as three months of age, even during school holidays. Local residents suspect that the use of plant protection products actually peaks during this holiday period. These children are quite unlike the 'standard individual' who, according to them, is a fundamental aspect of the approval procedure. Local residents are concerned that their children's intellectual capacities can be impaired by neurotoxic substances such as organophosphates and carbamates, as well as neonicotinoids (which, although new, are rapidly gaining ground). The fact that treated land is often freely accessible to playing children is a matter of concern for local residents. A few local residents want to know whether there are extra risks for children with asthma. Another question troubling local residents is whether sudden deteriorations in the health of elderly individuals might be associated with the frequent use of plant protection products in the immediate vicinity.

The local residents also expressed concerns about cancer. They wonder whether cancer cases in their own families or an increased incidence of cancer in the region might be related to the use of plant protection products in their immediate vicinity. This concern is fuelled by the realisation that some plant protection products, such as captan, have been classified as possible or probable carcinogens.

Local residents also report odour nuisance and vague, difficult to attribute symptoms such as inflammation, fatigue, irritation of the respiratory system, nasal congestion and anxiety. The latter symptom is much more intense during spraying. They also point to incidents of local residents becoming unwell. One such event occurred in October 2011, when those living in the vicinity of greenhouses in 's-Gravenzande were affected by the insecticide deltamethrin. The application of volatile soil fumigants, such as metam sodium, is often linked to health problems. This is especially true in extreme situations (where homes are surrounded by arable land on three sides) and under specific weather conditions

(such as windless and misty days). Local residents feel that it is not their job to identify health problems. They believe that it is the government's job to reduce people's exposure to 'involuntary' risks to an absolute minimum, and preferably to eliminate it entirely.

Local residents occasionally call attention to the careless (and sometimes even illegal) use of plant protection products by farmers and growers. In this context, they cite the misuse of spraying equipment, spraying without a screen and in excessively strong winds, leaving empty items of packaging behind in the field, and the use of non-approved products. Even though local residents are quite convinced that this contributes to the harm ultimately suffered, they nevertheless feel that it is inappropriate to lay the blame entirely on the farmers. After all, the real issue here is the intrinsic toxicity of plant protection products. Moreover, treated land continues to emit vapour for some considerable time after application, and there is little or nothing that farmers and growers can do to stop it. However, local residents have indicated that their dealings with farmers and growers are often difficult and that their requests for information about spraying are not met. They insist that there is a need for direct contact with farmers and growers about their use of plant protection products and about the possible risks to those living in the vicinity. Furthermore, local residents believe that the Netherlands Food and Consumer Product Safety Authority (NVWA) and the district water boards do not do enough to enforce existing regulations.

Local residents and environmental organisations state that they have often called for research into the exposure and health effects suffered by those living in the vicinity of land on which plant protection products are applied. Their view is that the numbers will not lie. They feel that, to date, their appeals have largely fallen on deaf ears. The quality of surface waters is continuously monitored and as a result, local residents feel that the authorities focus more on the health of water fleas than on the health of the residents themselves. They point to the large-scale study among local residents that is currently being conducted in the UK. They feel that this study could be most instructive. At the same time, they are well aware that it is not representative of the Netherlands, with its high population density and unique flower bulb cultivation sector, involving the intensive use of plant protection products.

Local residents and environmental organisations have expressed various wishes. They want objective information about the use of plant protection products, about the effects of human exposure, especially with regard to children (including unborn children), and about the risks associated with the cumulative intake of such products. They want a transparent trade-off between economic interests and health interests. They need information about how to act when

confronted with plant protection products in their living environment. They want studies to be conducted among local residents, studies that focus on the everyday situation in the Netherlands, i.e. Dutch studies. They demand the introduction of emission abatement measures. They would also like to see osier cultivation classified as part of the fruit-growing sector rather than as part of the arboriculture sector, so that it too would become subject to no-spray zones. In addition to better enforcement by the Netherlands Food and Consumer Product Safety Authority (NVWA) and the district water boards, they also want treated land to be closed off to children, and signs bearing warning symbols to be placed around treated land. Finally, they want to invoke the Spatial Planning Act as a way of protecting people's health.[see49]

2.2.2 *The perspectives of the agricultural sector, manufacturers and distributors*

In a joint presentation, the Dutch Federation of Agriculture and Horticulture (LTO), the Royal General Bulb Growers' Association (KAVB), the Dutch Fruit Growers Organization (NFO) and CUMELA (a contract workers' association) stressed that many of their members, together with their families and employees, are also local residents. For this reason, they place great importance on a safe environment in which to live and work. These agricultural organisations would very much like to draw a distinction between people's emotions and the facts of the matter, in terms of the risks to local residents. For this reason, they need an unbiased and independent advisory report. The occasional health problems (mainly allergic reactions) reported to them by their members always involve operators, and usually result from skin contact with undiluted products. They have no evidence of any health problems resulting from exposure in the home situation or in the day-to-day environment. Those working in greenhouse horticulture, together with agricultural contractors, are given periodic medical examinations by the Stigas occupational health and safety service. According to the agricultural organisations, these individuals' urine values and blood values never exceed safety standards.

These agricultural organisations point to the existing regulations in this area. Finally, the Board for the Authorisation of Plant Protection Products and Biocides (Ctgb) is reviewing the risks to operators, workers, and passers-by. There are also requirements for drift-reduction techniques, cultivation-free zones along watercourses, specific conditions of use and criteria for these products in municipal zoning regarding distances between housing developments and greenhouses and orchards.

One new development mentioned by the organisations is the European assessment framework that is currently on the drawing board. This will specifically address the risks to local residents, as part of the approval assessment. They also mention the 2012 Dutch action plan on sustainable plant protection. In this context, the agricultural organisations have expressed their willingness to extend the use of drift-reduction techniques from zones along watercourses to entire fields.

The agricultural organisations have indicated that they attach great importance to exposure studies in local residents. They hope that clear, independent and widely accepted data will clarify the risks to local residents, form the basis for clear communication, and help establish a European assessment framework. They have suggested a number of focal points for the exposure study, starting with up-to-date plant protection practice. Other points include an awareness of the variety of agricultural and horticultural situations involved (in connection with the issue of representativeness) and the traceability of sources of exposure.

The agricultural organisations have jointly indicated a need for independent information for farmers and horticulturalists (on how to reduce risks to the environment) and for local residents (on the usefulness, necessity and risks of plant protection). Their goal is to promote effective communication between farmers/growers and local residents. They were also saddened to learn, at the hearing, that this process can sometimes still go badly wrong. In this context, they see the UK's Good Neighbour Initiative as a shining example. Some organisations have even developed educational materials for their members, to help them establish good relations with local residents. The agricultural organisations have expressed their willingness to pick up the gauntlet.

The Dutch Crop Protection Association (NEFYTO; the trade association of the Dutch agrochemical industry) notes that plant protection products are among the most extensively researched and stringently assessed of all chemical products. The industry is constantly working on product innovation, one aim of which is to increase safety. The manufacturers believe that the current approval procedure implicitly guarantees the health of local residents, even if this is not stated explicitly. After all, the risk assessment focuses on those who suffer the highest levels and longest periods of exposure. These are the individuals who prepare and apply the spraying liquid.

NEFYTO emphasises that the European Food Safety Authority (EFSA) concluded, several years ago, that the current approach to the assessment of risks to those who apply plant protection products, to those who work with treated

crops, and to bystanders has no significant shortcomings. Nevertheless, the EFSA does consider that a number of points are not entirely satisfactory. Accordingly, it has put forward various proposals for improvement.

Both the United Kingdom and Germany have recently begun to specifically address the risks to local residents. NEFYTO has learned from German researchers that, for the great majority of evaluations, this process revealed no cause for concern regarding the health of local residents, bystanders and passers-by. Only a few applications required further refinement or risk reduction, especially in the case of multiple applications. NEFYTO concludes that current risk assessment procedures do indeed cover the risks to local residents, yet it appreciates that refinements to the risk assessment for local residents merit further attention. To this end, the manufacturers (through the ECPA, their European umbrella organisation) are calling for the rapid development of a European methodology. They assert that the debate should not result in a purely Dutch method.

In the United Kingdom, lengthy discussion between various government agencies has led to a careful consideration of the matter. The fruits of this process included the Good Neighbour Initiative. Together with the agricultural organisations, NEFYTO is committed to strengthening communication with local residents, using the approach developed for the British model.

Lastly, the manufacturers emphasise that there are numerous legal provisions governing the correct use of plant protection products. These same provisions also contribute, either directly or indirectly, to the safety of local residents. Contributing to integrated plant protection studies, as well as to projects targeting emission abatement and drift reduction, is something they see as a natural part of their product stewardship.

Agrodis, the trade association for distributors of plant protection products in the Netherlands, points out that the distributors have launched a range of initiatives in this area. For instance, traders dealing in professional plant protection products must be properly certified. Customers must have a certificate of professional competence. Distributors are an important source of information for growers, and Agrodis wants to augment its consultancy work still further. To this end, the organisation has created a website on the topic of plant protection (www.gewasbescherming.nl). Together with other stakeholders, Agrodis has signed the Sustainable Plant Protection Covenant. In this context, the organisation is participating in various projects such as *Versterking Monitoringgegevens* (‘Strengthening Monitoring Data’), *Schone Bronnen* (‘Clean Sources’), *Telen met Toekomst* (‘Farming the Future’), and *Schoon Water*

Brabant (‘Clean Water for the Province of Brabant’). According Agrodis, plant protection in the Netherlands is already very effectively regulated. As evidence of this, the organisation cites the approval procedure and the numerous rules governing the correct use of plant protection products in the everyday situation. There is also EU legislation, such as the Directive establishing a framework for Community action to achieve the sustainable use of pesticides (Directive 2009/128/EC).

Regarding the possible risks to local residents, Agrodis would very much like the advisory report to focus on the health of this group. To this end, information must first be collected. Agrodis wants a clear distinction to be drawn between people’s perceptions and hard science. It also wants to understand the true scale of the problem. Are these just individual incidents or is there an underlying systemic problem here? With regard to the new Policy Document on Sustainable Plant Protection, Agrodis believes that a separate section should be devoted to local residents. The organisation points out that the good relations between the various stakeholders in the field of plant protection form an excellent basis for tackling the issue. Should any new, objective information become available, then Agrodis has the means to distribute this to stakeholders very quickly, via the above-mentioned website, for example.

2.3 Conclusions

For thirty years now, concerns have been expressed (primarily by local residents themselves) about health effects resulting from the use of plant protection products in those living in the vicinity of agricultural land. These concerns relate to various types of plant cultivation. They are associated with an intensive use of products, with application techniques that tend to exacerbate dispersion to the environment, and with limited distances between treated land and homes. Minimum distances do apply to some types of plant cultivation, and these are included in municipal zoning. Studies into risks in the Netherlands have been almost completely limited to exploratory model-based calculations, plus some analyses of samples of air, soil, water, house dust, and vegetable gardens.

At a hearing held by the Committee, it emerged that local residents are most concerned about the health of their children and about cancer. They feel that the approval procedure for plant protection products mainly assesses the risks to operators. Another criticism is that no consideration has been given to exposure to combinations of plant protection products. Local residents feel that the authorities are not always receptive to their reports about health problems or

about the incorrect use of such products. They feel that organisms living in ditches and watercourses enjoy greater protection than they themselves do.

Farmers and growers see themselves as a large group of local residents. Together with manufacturers and distributors, they point out that much has been done to enable plant protection products to be used safely. They are constantly working to achieve further reductions in emissions. In their view, the risks to local residents are minimal. Growers are more concerned about encroaching housing developments and the resultant restrictions on their business operations. Nevertheless, they are keen to engage in dialogue with local residents. They would prefer any methods for assessing the risk to local residents to be adopted at European level.

All of the stakeholders hope that an independent study conducted among local residents will clarify the situation.

Chapter 3

Chemical plant protection with a view to human health

Chemical plant protection products are designed to combat pests. However, they can also harm other organisms. Accordingly, a wide range of measures have been implemented to promote the safe use of these products. For instance, products cannot be marketed until they have successfully completed a detailed approval procedure. This procedure places great emphasis on any risks to human health that might result from a product's proposed use. The Committee briefly outlines the historical origins of that procedure. It then conducts a closer examination of the implications. Next it addresses the gaps in that procedure, and the international efforts to close them. It goes on to deal with various other facets of plant protection policy, which are intended to govern the correct use of products in everyday situations. There is a special focus on the significance of all this for local residents.

3.1 Introduction

For as long as people have farmed the land, they have tried to protect their crops. They have sheltered them from wind and weather. They have kept out wild animals or chased them off, to stop them damaging or trampling the crops. They have dug up any weeds that threatened to overwhelm the crop. Traditionally, they have attempted to control smaller pests and pathogens, such as lice, beetles, moulds and nematodes with simple chemicals such as wood ash, lime, sulphur, arsenic, metals (copper, lead) and substances extracted from plants (nicotine,

rotenone and pyrethrum). However, as agriculture increased in scale and became more intensive, there was an increased need for chemical plant protection. Developments in the science of chemistry made it possible to manufacture more powerful, synthetic preparations. In the period after the Second World War, this trend really took off. Today, farmers and growers have access to a wide range of chemical products for the control of harmful insects, moulds, nematodes and weeds.

3.1.1 *The first legislation*

As these chemical products were increasingly used, it became apparent that they also suffer from a number of drawbacks. Pests are able to develop resistance and other plants and animals can be unintentionally harmed. They even pose risks to human health. In 1962, the publication of a book entitled 'Silent Spring', by the American writer and biologist Rachel Carson, greatly contributed to a growing awareness of the risks involved.[10] A few years later, a similar book, entitled 'Silver Veils and Hidden Dangers' by Cornelis Jan Briejèr, was published in the Netherlands.[11]

The need arose for legislation on the correct use of plant protection products. In 1962, the Pesticides Act came into effect. Initially, this focused purely on the efficacy of such products, i.e. on whether they actually do what the manufacturer promises. Soon, however, supplementary provisions were added to the Act which set limits on the risks to humans and the environment. From then on, it was only permitted to market products that had been shown to comply with all efficacy and safety requirements. The government then established a supervisory body, the Committee for the Authorisation of Pesticides. In 1993, this became the Board for the Authorisation of Pesticides (CTB). In the year 2000, the CTB became an independent agency. Any manufacturers wishing to market a product must first submit an application to the CTB. They must prepare 'statutory conditions of use' containing details of the crops for which the product is intended, the diseases or pest infestations targeted, and how the product can be used effectively and safely. The application must be accompanied by a comprehensive and accurately defined data dossier on which the approval authority can base its assessment. Similar trends took place in other Western countries. Partly in response to increasingly stringent requirements, industry has invested a great deal in product development and continues to do so[50] (see also http://www.nefyto.nl/Thema-s/Innovatie, accessed on 27 November 2013). Thus, in terms of safety, a great deal has been achieved in the past 50 years. Modern plant protection products are more selective and more readily degradable than

those used in the past. They no longer accumulate in the bodies of humans and animals.

3.1.2 *European harmonisation*

The formation of the European Union led to a growing need for mutual harmonisation, both among the governments of the member states and among stakeholders. They want to prevent the creation of trade barriers, operate efficiently, and remove unnecessary differences between member states. Fairness dictates that the same rules should apply to everyone (level playing field). Since then, approval policy and the entire body of law have been extensively harmonised. European Regulation (EC) 1107/2009 now sets the standard.[51] In 2011, this replaced the 1991 Council Directive 91/414/EEC concerning the placing of plant protection products on the market.[52] To implement the European rules in Dutch legislation, the 1962 Pesticides Act was replaced in 2007 by the Plant Protection Products and Biocides Act (Wgb). Since that time, the CTB has been known as the Ctgb.[4] In December 2011, Dutch law was adapted to Regulation 1107/2009.

Current plant protection products are generally mixtures of substances (known as formulations). In addition to an active ingredient (which usually kills the pest) they often contain several adjuvants. Today, member states may only approve plant protection products whose active ingredient appears on an EU positive list. While the EU is responsible for placing active ingredients on the positive list, national approval authorities are extensively involved in this process. Inclusion in this list is based on a comprehensive dossier that manufacturers are required to supply. The national approval boards continue to be responsible for the approval of formulated commercial products (plant protection products). It should also be noted that the European Union is currently divided into three zones: north, central and south. The Netherlands and its neighbours are located in the central zone. In terms of greenhouse cultivation, however, there is only a single zone. If a plant protection product is approved by one country then, in theory, it must also be approved by all the other countries in the same zone. Exceptions to this rule are permitted, provided that there are special national circumstances to justify this. The active ingredients on the positive list (and, thus, the approved plant protection products as well) are periodically reassessed (at least once every ten years). This is because the test protocols used in the approval procedure are regularly updated in line with the latest findings. If previously unsuspected harmful effects come to light in the course of everyday practice, the approval is reviewed as soon as possible.

3.1.3 *Broad summary of the scale of use in various types of plant cultivation in the Netherlands*

The annual use of plant protection products in Dutch agriculture and horticulture now corresponds to more than 8 million kg of active ingredient (see Annex G).[3] The trend is declining slightly. In recent years, given that the area of land under cultivation has remained more or less the same, there has been a slight decline in the use of plant protection products per hectare of agricultural land. The average is currently almost 5 kg/ha/yr, but this varies widely from one type of plant cultivation to another. Currently, less than a kilogram per hectare per year is applied to grassland used by the livestock industry. The corresponding figure for the flower bulb cultivation sector is about 75 kg. While the area of land under cultivation in that sector is relatively small (slightly over 1 percent of the total area under cultivation) it accounts for nearly 20 percent of total product use. Other types of plant cultivation that demand a relatively intensive use of plant protection products are greenhouse floriculture (nearly 50 kg/ha/yr) and the fruit-growing sector (40 kg/ha/yr).

Over the past ten years, thanks to a range of emission abatement measures, emissions to the environment have been cut by 30 to 50 percent. Nevertheless, an average of approximately 10 percent (the amounts differ depending on the exact plant protection product and application method used) of the applied quantity of plant protection products disperses from the treated area and enters the air, surface water, or ground-water.[3] Emissions to the air are far greater than those to ground-water and surface water. That amount is the sum of a number of different pathways, such as vaporisation during spraying in open field cultivation, vaporisation from plants and from the soil after application (open field cultivation), and emissions from greenhouses. The main determining factors are the volatility of the substance in question, the method of application and the weather conditions during and after application. However, concentrations in the air generally fall rapidly with increasing distance from the source, because of the high level of dilution involved. Moreover, most of these substances break down fairly rapidly in air. They usually have a half-life of less than two days. This does not mean that dilution and breakdown in the vicinity of treated areas inevitably lead to low concentrations in the air. At short distances from the source there is negligible dilution, and breakdown takes time. Under stable weather conditions in particular, dilution is limited and there can be temporary, sharp increases in concentration around treated areas.

3.2 Assessing the risks to humans as part of the approval procedure

3.2.1 A meticulous and comprehensive assessment

An assessment of the risks to human health is a major component of the approval procedure. During the hearing, the Committee discovered that local residents (and possibly other stakeholders as well) had only a limited knowledge of such matters. For this reason, the Committee has included a more detailed description of this assessment in Annex H. Below, it has restricted itself to a graphical representation (Figure 1) and a brief description of the basics.

The risk assessment is aimed at all those who might come into contact with a product, either while it is being used or at some later stage. Almost all such cases involve 'involuntary' exposure. The same applies to the operators themselves, who are expected to avoid exposure. In addition to those making occupational or personal use of such products, the assessment is aimed at those carrying out agricultural activities in the area during application, non-casual occupational bystanders and passers-by (no distinction is made between these two groups). There is also a focus on the risks to those who have to work with treated crops for some time after the product has been applied. If the crops involved are intended for human consumption then the risks to consumers are also assessed. This is because small traces of plant protection product (residues) can remain in the crop. Where appropriate, differences between men and women are taken into account.

The operators, workers handling treated crops, non-casual occupational bystanders and passers-by, and consumers can include pregnant women. Accordingly, the risks to the unborn child are also assessed. When assessing the risk to consumers, a separate examination is also made of the risk to young children. Unlike those in adults, the organs and organ systems of unborn children and young children are still developing. The formation and maturation of the central nervous system, the immune system and various hormonal systems are complex processes that can, to some extent, continue beyond puberty. Chemicals can disrupt these developmental processes, possibly resulting in permanent health impairment. In addition, young children in particular have different patterns of consumption that might result in anomalous levels of exposure.

The largely harmonised procedure used within the European Union provides for the derivation of health-based limit values (A(O)EL, ADI, ARfD, see Figure 1). All available knowledge suggests that, at exposures below these levels, no health effects are to be expected in men, women and children. These

values are derived from the results of experimental animal research, as trials in humans are precluded for ethical reasons. The numerous experimental animal studies aim at covering all the conceivable short-term or long-term health effects that might occur following single or repeated exposures. In order to derive human limit values, an additional safety margin or uncertainty margin (a factor of 10) is built-in. An additional margin (a further factor of 10) is then incorporated to be sure that the limit values would also apply to those who, for whatever reason, are particularly susceptible.

The resulting health-based limit values are compared to the estimated exposures suffered by operators, workers handling treated crops, bystanders, passers-by, and consumers. Account is taken of both short-term peak exposures and long-term, usually lower exposures. The estimates are made using mathematical models. If the calculated exposure for all groups remains below the health-based limit values, the product in question is approved. If there is any doubt involved then further research, or more refined exposure calculations, may be carried out. If these steps fail to remove the doubt, then the product is not approved.

As yet, the approval procedure in the Netherlands does not involve a separate assessment of the risks to local residents. An exception is the risks to those living in the vicinity of greenhouses, which, in the Netherlands, are assessed using a national methodology. The Dutch approval process for plant protection products takes no account of risks to casual non-occupational bystanders and passers-by, which may include children. Accordingly, the assessment focuses mainly on the risks to those in the agricultural profession (as local residents and environmental organisations suspected during the hearing). Nevertheless, according to the Committee, this does not mean that all local residents, casual non-occupational bystanders and passers-by (including children) in the Netherlands are currently completely unprotected. Limitation of the risks to operators, workers, non-casual occupational bystanders, consumers and the environment implicitly also offers some degree of protection to local residents, casual non-occupational bystanders and passers-by. This does not detract from the fact that the Committee sees individuals in these groups as being potentially at risk, particularly in special situations where a high degree of sensitivity and a high level of exposure are combined.

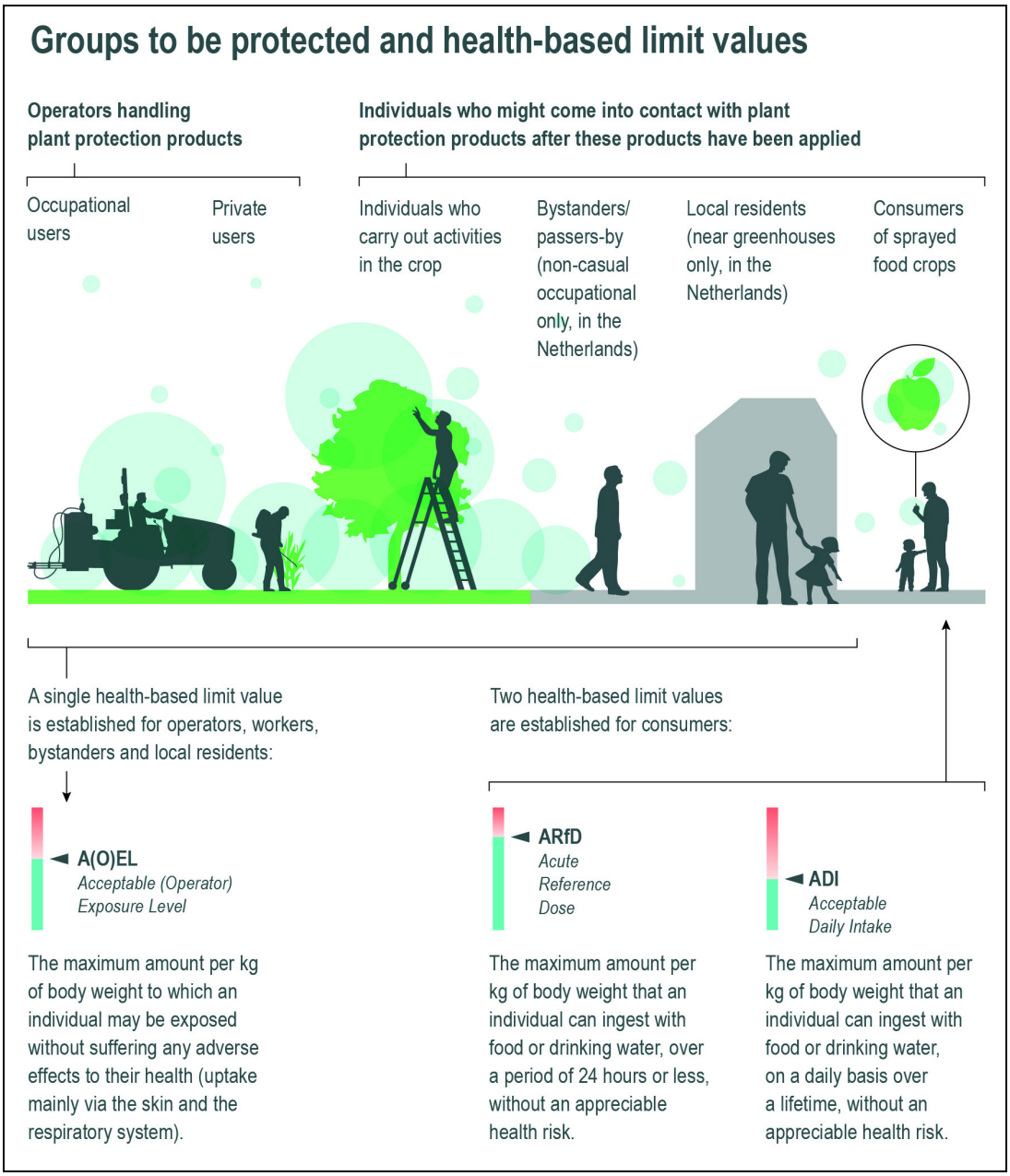


Figure 1a Assessing the risks to humans as part of the approval procedure for plant protection products; groups to be protected and health-based limit values.

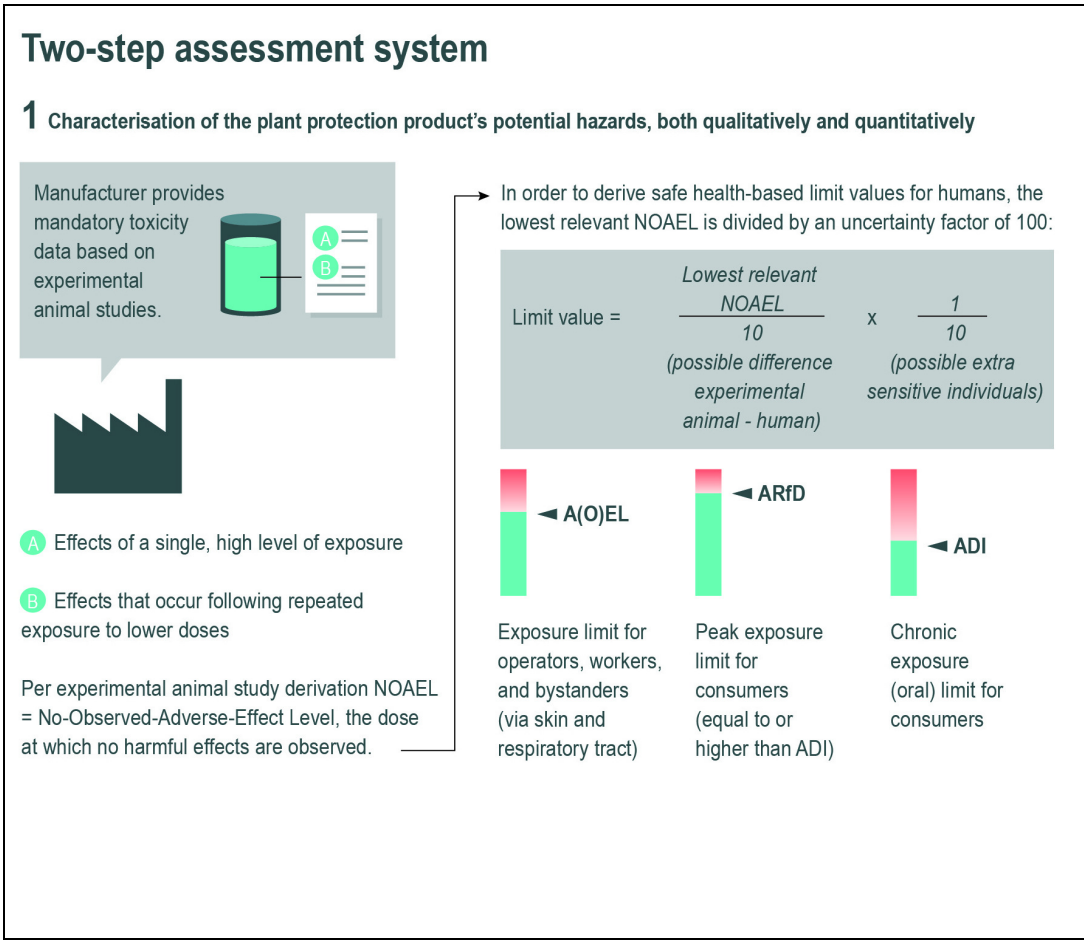


Figure 1b Assessing the risks to humans as part of the approval procedure for plant protection products; derivation of health-based limit values.

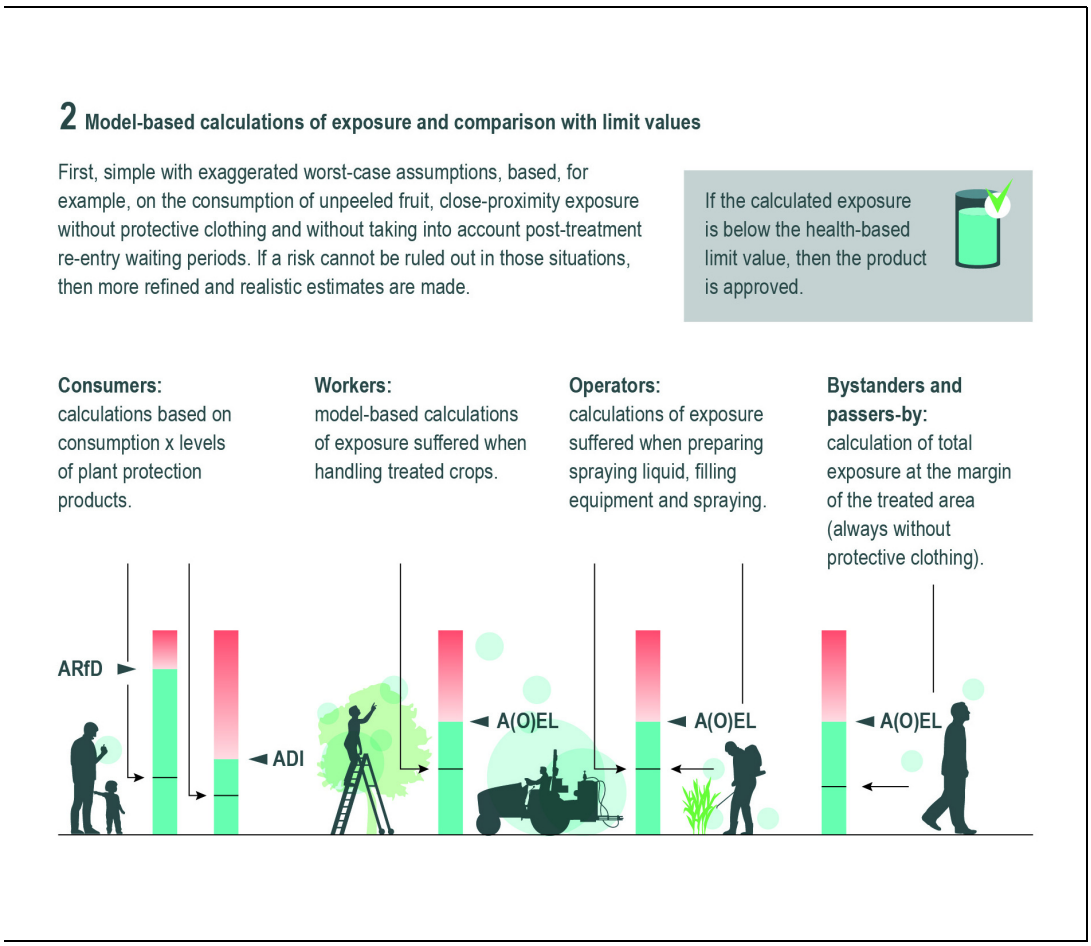


Figure 1c Assessing the risks to humans as part of the approval procedure for plant protection products; estimating exposure and comparison with health-based limit values.

Assessments are always based on the use proposed by the manufacturer. Approval means that the product in question is suitable, i.e. that the assessors have determined, to the best of their ability, that it *can* be used to combat pest infestations effectively and safely. Supplementary measures are in effect to ensure that this is actually carried out in practice. The Committee explores this aspect in greater detail in Section 3.3.

3.2.2 Improving the assessment methods

At the international level, the regulatory authorities are constantly seeking to make further improvements to the assessment methodologies. This effort is based on new scientific knowledge and on the lessons learned from real-life experiences. The approval procedure is, and will remain, a work in progress. If society wants the development of plant protection products to remain economically viable, it cannot go on tightening its safety requirements forever. A balance must be struck between human health, the environment and other societal interests, such as food production. The matter of what constitutes the right balance and how safe is 'safe enough', is a political issue. The Committee goes on to discuss some recent developments.

The improved detection of effects on the unborn child

Several years ago, the Health Council noted that, despite all efforts to the contrary, some effects of plant protection products on the development of young experimental animals – and therefore on children (including unborn children) – can go undetected in the approval procedure.[53] This particularly applies to effects on the nervous system, immune system, and hormonal system.[54-56] The harm caused in such situations is often permanent, and can even extend to future generations. For this reason, those responsible for international policy on chemicals are now considering replacing the conventional animal testing that is currently used to detect such effects[57] with a newly developed test that offers improved detection capabilities[58]. This new test uses fewer experimental animals while measuring more parameters that can provide information about possible effects on the development of the above-mentioned organ systems.[59] In an advisory letter issued at the end of 2012, the Health Council stated that the new test is preferable to the old one. It recommended that the new test be introduced into the national and international approval procedures for chemicals (REACH).[60] While the new test can now be used for the approval of plant protection products in the EU, it is not yet officially preferred over the old test.

Very recently, the EFSA has pushed for improvements to be made to the current strategy for detecting the effects of plant protection products on developing nervous systems.[61]

Modified procedure for assessing risks to operators, workers, bystanders and local residents

The EFSA Panel on Plant Protection Products and their Residues (EFSA PPR Panel) has recently reappraised the risk assessment procedure for operators, workers, bystanders and local residents within the European Union.[8] According to the EFSA PPR Panel, there is no evidence that the current methods used to assess the risk to these groups of people suffer from any major shortcomings. Nevertheless, the panel felt that current methods are not entirely satisfactory. This is because, in some exposure situations, there is scant monitoring data to substantiate model-based calculations. In other situations, several models are available that all lead to different outcomes. Finally, the current approach can sometimes underestimate the peak exposure of the above-mentioned groups. Accordingly, the panel has suggested a number of modifications.

The most notable modification advocated by the EFSA PPR Panel is that, in addition to a health-based limit value for chronic exposure, values should be determined for the peak exposures of operators, workers and bystanders, rather like the ARfD for consumers. This acute A(O)EL (AA(O)EL) would then have to be established for all plant protection products with high acute toxicity, i.e. the ability to harm health through a single, short and high peak exposure. The panel felt that there is no need to carry out separate assessments of this kind for local residents. This is because any acute risks to them are covered by the assessment of acute risks to bystanders. Conversely, the risks of prolonged exposure need not be assessed separately for bystanders (if this is indeed necessary), as they are covered by the assessment of the risks posed by chronic exposure to local residents.

The panel determined that there is little monitoring data on the exposure of bystanders and local residents. Furthermore, it noted that there are no standardised, validated methods for deriving model-based estimates of the exposure suffered by both groups. Different countries take different approaches. The panel has put forward proposals for a unified approach. The EFSA Panel recommends that four exposure pathways, which are deemed important, should be taken into account when estimating the exposure of bystanders and local residents: direct exposure to spray, direct exposure to vapour, exposure by entering treated areas, and indirect exposure through contact with contaminated

surfaces. The exposures from each of these pathways would then be totalled. The proposals specifically take account of the fact that bystanders and local residents can include children. The difference between the risk assessments for bystanders and for local residents is primarily that, for the former, the focus is on the risks of short, relatively high exposure peaks while, for the latter, greater emphasis is given to more chronic exposure.

The lack of standardised, validated methods for estimating the exposure of bystanders and local residents has prompted the launch of several projects in Europe. In the United Kingdom, the Bystander and Resident Exposure Assessment Model (BREAM) project has been completed.[62,63] One striking finding was that, in some situations, the exposure of bystanders and local residents resulting from spray drift can be as much as ten times higher than was previously suspected. The EU-funded Bystanders Residents Operators and WorkerS Exposure (BROWSE) project was launched in early 2011 and will continue until mid-2014 (https://secure.fera.defra.gov.uk/browse/index.cfm). The Netherlands is participating in this project. As yet, no results have been published. Finally, a study is currently taking place in the UK into the presence of plant protection products (or their metabolites) in the urine of local residents.[9] The aim is to verify the UK approval procedure's current estimate of local residents' exposure. The results of the study are expected in 2014.

In Chapter 7, the Committee further examines the feasibility of using the EFSA panel's proposals to close the gap that has been identified in the national approval procedure.

Local effects and sensitisation

The assessment of risks to human health places great emphasis on the detection and prevention of 'systemic' effects. These are health effects that occur after a substance has been absorbed and has spread throughout the body. Local effects in areas of the body that come into direct contact with a substance feature only marginally in the approval procedure. These effects include irritation of the skin, eyes, or respiratory system, and any resultant sensitisation.[64] The A(O)EL is a systemic value. The results of the research into irritation and sensitisation that forms part of the approval procedure are, therefore, used primarily to determine the risk and safety phrases that must be printed on the packaging. Operators and workers must protect themselves against local effects through the use of personal protective equipment, such as gloves. The same cannot be expected of casual non-occupational bystanders and passers-by, nor of local residents. They may, therefore, be exposed to sensitising substances. It should be noted that the more

these substances are diluted, the smaller their sensitising effect is. A plant protection product used in agriculture is usually diluted over a hundred times before being used in spraying. This reduces the risk that the threshold value for sensitisation will be exceeded if local residents or bystanders are exposed to spray.

Simultaneous exposure to several different substances

Exceptions aside, assessing the risks to humans in the context of the approval procedure is carried out on a product by product basis. However, some individuals can be exposed to several different substances more or less simultaneously. This may, for instance, be the case if different products are applied in quick succession. As a result of measures to combat the development of resistance by pests, food crops often contain the residues of several different products.

The significance of such combined exposure, in terms of health, depends on how the substances in question relate to each other.[65-67] For example, a range of substances may each exert their effect through the same mechanism of action, such as the inhibition of a particular enzyme in the body. In such cases, the impact on health can be estimated by totalling the individual exposure levels, weighted by the degree to which they exert the effect in question (dose addition). Substances can also exert similar effects via different mechanisms of action. In such cases, their combined effect can be derived from the sum of their individual effects (effect addition). In both of the above-mentioned cases, the various substances essentially work independently of each other. However, substances can also influence each other's effects. One possibility is that one substance will boost the concentration of another substance in human tissues, either by promoting its uptake by the body or by inhibiting the breakdown and excretion of that substance. Finally, one substance can augment the action of another substance. Both of the latter cases are examples of synergy. The opposite effect is known as antagonism. In the case of synergy and antagonism, there are no simple rules of computation that can be used to estimate the combined effects of different substances. This can only be done experimentally. Synergy is probably a relatively rare phenomenon.[66-68]

The first type of combination toxicity (substances with the same mechanism of action) appears to be particularly relevant to the risk assessment of plant protection products. After all, many products on the market have the same mechanism of action. One example is the organophosphates, a group of neurotoxic insecticides that all inhibit the enzyme acetylcholinesterase. Even if

exposure to each individual plant protection product is consistently beneath the health-based limit value, the combined action of all these products can be powerful enough to trigger harmful effects. Much the same goes for other groups of products. Thus an approval procedure that is based on the assessment of individual plant protection products can lead to an underestimation of the risks involved.

In the EU, the Regulation concerning the placing of plant protection products on the market dictates that account must be taken of exposure to more than one product.[51] An assessment of the risks posed by exposure to more than one plant protection product is known as a 'cumulative risk assessment'.[69] Intensive efforts are being made to develop the complex methodology required,[70] one example being the ACROPOLIS project.[71] These efforts primarily target dietary exposure, i.e. consumers.[72-74] The development of a methodology for the cumulative risk assessment of operators, workers, bystanders and local residents has barely begun.[75]

Exposure from a range of sources and by different pathways

People can come into contact with the same plant protection products from a range of sources and via different pathways. Consumers will do so through their food, while the operators or workers make occupational use of such products. Others will be involved as bystanders or local residents, or those who make personal use of these products in the home and garden. The risks are assessed separately for each of these different situations. The fact that one and the same individual might be involved in each case is ignored to some extent. In addition, substances used as active ingredients in plant protection products may also be present in other products, such as biocides, veterinary medicines, medicinal products, and cosmetics. These products are subject to different legal regimes, and their safety is assessed separately. However, each of these applications can also contribute to exposure to the same substance. Assessment of the risks from exposure to a single substance from all sources and via all pathways is known as 'aggregate risk assessment'.[69] Here too, the requisite methodology is still under development.[71,75]

3.3 Policy aimed at safe and sustainable use

3.3.1 Legislation that regulates use

In addition to the approval procedure, the Plant Protection Products and Biocides Act (Wgb) regulates various other aspects aimed at promoting the safe and effective use of these products in the everyday situation. For instance, those who apply plant protection products in a professional capacity must be in possession of a certificate of professional competence (formerly known as a spraying licence). Such certificates are valid for a period of five years. In order to get their certificate renewed, these individuals are required to take regular refresher courses. The statutory conditions of use are printed on the packaging of plant protection products. These give details of which pest is to be targeted in which crop, and of how the product should be used. The packaging also bears risk and safety phrases that inform users about hazards to human health and to the environment, and about the associated preventive measures. This includes the use of personal protective equipment, such as gloves or respiratory protection. Workers handling treated crops may be subject to waiting periods before they are permitted to resume this work. These periods are more protracted in the case of young people, as they may have a higher level of sensitivity. The law also prescribes that spraying equipment must be regularly checked and that emission-reducing nozzles must be used. Growers must also draft a plant protection plan and keep a log indicating exactly what products were used, when, in what quantities and on which areas of land. Finally, there are safety requirements governing the storage of plant protection products and the disposal of residues and empty packaging.

In addition to the Plant Protection Products and Biocides Act, agricultural holdings are subject to the Working Conditions Act. This makes it mandatory for agricultural holdings that have employees to carry out a risk inventory and evaluation (RI&E). That is a summary of an agricultural holding's work safety risks, and an action plan for minimising those risks. It goes without saying that, in an agricultural holding, dealing with plant protection products is part of a risk inventory and evaluation. Finally, agricultural holdings also have to comply with various environmental laws. The Inspectorate SZW, the Netherlands Food and Consumer Product Safety Authority (NVWA) and the Human Environment and Transport Inspectorate (ILT) monitor compliance with this legislation.

3.3.2 *Sustainable plant protection*

However well the approval and use of plant protection products are regulated, these are still hazardous substances. In recent years, this has prompted the government of the Netherlands to make plant protection more sustainable. It interprets sustainable plant protection as plant protection that secures food production through the effective control of pest infestations and diseases, while at the same time minimising the risks to human health, wildlife and the environment.

In addition to the safety measures outlined above, sustainability will require chemical plant protection to be embedded into 'integrated' plant protection. This is a much broader approach to the control of diseases and pest infestations. That starts with preventive measures to block diseases and pest infestations. These might include habitat optimisation, crop rotation, and the use of more resistant varieties. If diseases and pest infestations still occur, then priority is given to mechanical control (e.g. weeding), physical control (e.g. steaming or burning) and biological control (e.g. natural predators of pests). The use of chemical plant protection is limited as much as possible. If these products have to be used, then farmers and growers can choose those that are least harmful to the environment. They can obtain a certain amount of guidance in this regard from the 'Environmental Yardstick' (see www.milieumeetlat.nl).[76] As yet, however, this instrument is relatively poorly tailored to human health.

In 2003, the government and a large number of stakeholders signed the Sustainable Plant Protection Covenant, to promote integrated plant protection. A year later, the then Ministry of Agriculture, Nature Management and Fisheries published the Policy Document on Sustainable Plant Protection. This set quantitative policy objectives up until 2010, for the ecological quality of surface waters, for drinking water extraction, for breaching the standards for residue levels in food, and for occupational safety.[77]. All of this is entirely in keeping with developments in Europe. The recent EU Directive establishing a framework for Community action to achieve the sustainable use of pesticides[78] obliges member states, as of 2012, to draw up a National Action Plan for Sustainable Plant Protection, and to submit this to the European Commission for consideration. The Netherlands has complied with this directive.[79]

3.3.3 *Evaluation of plant protection policy*

The Evaluation of the Policy Document on Sustainable Plant Protection was published in early 2012.[80] This assessed the extent to which the formulated policy objectives had been met. It appears that the environmental objectives, especially those relating to water quality, have only been partially met,[3] while those relating to food safety have been fully met.[81] When measurements in food products are compared to health-based limit values, it can be seen that food is now safer.

In the field of occupational safety, the policy objectives have not been met.[82] For instance, some agricultural holdings with one or more employees failed to carry out the mandatory risk inventory and evaluation (RI&E), even though 100% participation was the aim. Most agricultural holdings did conduct an RI&E, but few make active use of this in practice. Moreover, these RI&Es are usually incomplete. Virtually no agricultural holdings carry out the mandatory assessment of workers' exposure (nature, extent and duration) to plant protection products. No farmers and growers have submitted any such request to an occupational health and safety service, not even to Stigas, which specifically serves the agricultural sector. The growers have indicated that they lack the expertise required to carry out an assessment of this kind. Anyway, they consider such a review unnecessary because, during the approval process, it is established that the product in question – when used in accordance with the conditions of use – poses no unacceptable risks to operators, workers or bystanders. According to the authors of the evaluation report, however, the growers are overlooking the fact that an approval is a generic assessment. The risk inventory and evaluation can, and should, include agricultural-holding-specific conditions, such as exposure to several different products. A full risk inventory and evaluation can also provide the incentive to compare products from the point of view of safety, and to implement measures at the source.

The authors of the evaluation report conclude that existing awareness-raising training about the risks of using plant protection products needs to be improved.[82] Some growers admit that they do not provide their staff with this type of training, and many employees say that they have never been informed about the risks involved. One sticking point is that workers and employers do not fully comply with the re-entry intervals. These are the prescribed periods between treating a crop with plant protection products and allowing people to work in that crop again. This is especially true of young workers below the age of 16, for whom a longer period of two weeks is mandatory, due to their

potentially higher level of sensitivity. This period is seen as unworkable. Moreover, workers re-entering a treated crop wear virtually no protective clothing, even when this is dictated by the conditions of use. Accordingly, the evaluation report's main conclusion with regard to working conditions is that growers assign a low priority to safe working practices when it comes to plant protection products. The government, too, has been relatively inactive for quite some time. From 2007 to 2012, the Labour Inspectorate (now the Inspectorate SZW) carried out no specific investigations into the safe handling of plant protection products. In 2012, the Inspectorate SZW investigated more than four hundred greenhouse horticulture agricultural holdings. A total of 376 violations were detected in 51 percent of these agricultural holdings. More than a quarter of these violations involved inadequate measures to curb the risk of exposure to plant protection products.[83]

According to the evaluation report, there is only a poor level of compliance with regulations in the area of plant protection.[82,84] With regard to certificates of professional competence (formerly known as a spraying licence), storage of products and the disposal of residues, growers are generally good at adhering to the rules. However, there is limited compliance with the obligation to use only approved products. Many growers (ranging from over 20 percent in the flower bulb cultivation sector to over 80 percent in the floriculture sector) use non-approved products or have them in stock. Recent research by the Netherlands Food and Consumer Product Safety Authority (NVWA) in the fruit-growing sector has confirmed the use of non-approved (for the relevant crop) products.[85] The sector also performs poorly in terms of the mandatory use of emission-reducing nozzles. This poor level of compliance may result from the complexity of regulations and fears of economic damage.

The Committee concludes that evaluations in the area of occupational safety[82] are not based on measurements but on returned questionnaires and inspections. In this respect, they are totally unlike policy evaluations in the areas of environmental quality[3] and food safety[81]. Measurements that might shed light on the actual exposure of operators and workers were not presented. The Evaluation of the Policy Document on Sustainable Plant Protection does not address the risks to bystanders and local residents.[80] Nor were any objectives formulated for these groups.

A new Policy Document on Sustainable Plant Protection has since been published that gives direction to the policy for 2013 to 2023.[86] That document specifically addresses the sticking points that have been identified. This second Policy Document also focuses specifically on the risks to those living in the

vicinity of land on which plant protection activities involving the use of chemical products are carried out. It has been announced that follow-up activities relating to the risks to local residents will be based on the present Health Council advisory report.

3.4 Conclusions

The Committee has determined that, for many years now, enormous efforts have been made to enable plant protection products to be used more safely and more sustainably. International cooperation has resulted in the establishment of a comprehensive and meticulous approval procedure. The regulatory authorities are constantly seeking to make further improvements and refinements, based on new results from scientific research and on the lessons learned from real-life experiences. These improvements increasingly involve risks that can only be estimated by the use of complex methods. This includes risks such as those arising from exposure to several different substances at the same time, and from exposure to a single substance from a range of sources and by different pathways. In addition, there is still a gap in terms of the assessment of risks to bystanders (including passers-by) and to those living in the vicinity of agricultural land. The Dutch approval procedure currently focuses only very marginally on risks to the former group (only non-casual occupational bystanders and passers-by), and not at all on risks to the latter group (with the exception of those living in the vicinity of greenhouses). Current models for assessing the exposure suffered by local residents, bystanders and passers-by have yet to be harmonised at the international level, and their reliability has only been verified to limited extent. While proposals for improvement have been put forward, these have not yet been implemented. This does not mean that all local residents, casual non-occupational bystanders and passers-by in the Netherlands are currently completely unprotected. Limitation of the risks to operators, workers, non-casual occupational bystanders and passers-by, consumers and the environment also offers some degree of protection to local residents, casual non-occupational bystanders and passers-by. This does not detract from the fact that the Committee sees individuals in these groups as being potentially at risk of health impairment, particularly in situations where an exceptional degree of sensitivity and a high level of exposure are combined. This is especially true of local, non-systemic effects, which feature only marginally in the approval procedure. Irritation affecting the skin, eyes or upper respiratory tract can be prevented if operators and workers use personal protective equipment. The same

cannot be expected of casual non-occupational bystanders, passers-by, or local residents. Repeated exposure could lead to sensitisation.

Approval means that the product in question can be used to control plant diseases and pest infestations effectively and safely, provided that its conditions of use are properly observed. A wide range of measures are in effect to ensure that this is actually carried out in practice. These involve legislation, regulations, proper instruction, training and supervision. As this ultimately involves hazardous substances, the Dutch government has committed itself to sustainable plant protection, together with the European Union and in consultation with stakeholders. The cornerstone of this policy is integrated plant protection, the aim being to limit the use of chemical products as much as possible. During a recent evaluation of that policy, however, it was found that farmers and growers do not assign sufficient priority to safety in the context of their business operations. Nor do they comply fully with the relevant legislation and regulations, for instance with regard to non-approved products. The impact of this is not limited to their own safety or to that of their employees and their families. It also increases the risks to local residents.

In the following chapters, the Committee conducts a closer examination of what is known about the exposure suffered by farmers, growers and local residents, and about the state of their health.

Chapter 4

Exposure and health of farmers and growers

A meticulous approval procedure, together with a wide range of measures to govern the correct use of chemical plant protection products in everyday practice, is intended to guarantee that these products are used safely. Yet how effective is this policy? Despite these provisions, is there any evidence, in the everyday situation, of relevant exposure levels and health effects in people? In formulating an answer to that question, it is useful to first focus on those who make occupational use of such products. After all, those who apply these substances or who come into contact with them by virtue of their work often suffer higher levels of exposure than the general population.[87] This is certainly the case if they do not take adequate steps to limit their own exposure. Ultimately, the effectiveness of the policy also has knock-on effects for local residents. In this chapter, therefore, the Committee briefly discusses what the scientific literature has to say about the exposure and health effects suffered by operators working with plant protection products and by workers handling treated crops.

4.1 Exposure of farmers and growers

Past studies carried out across a range of agricultural sectors in the Netherlands have investigated the exposure suffered by operators working with plant protection products and by workers handling treated crops. The sectors investigated included the flower bulb cultivation sector,[88,89] the floriculture

sector,[90-92] and the fruit-growing sector.[93-95] This involved both exposure via the skin and exposure via the respiratory system. Exposure occurs during the application of plant protection products, but even more so when preparing the spraying liquid, cleaning the equipment, and working with treated crops. The degree of exposure is highly dependent on the nature of the product, the application method used, the frequency of application, and the use of personal protective equipment and enclosed tractor cabs. Exposure levels in excess of the health-based limit values that are considered safe were occasionally encountered.[89,90] Over the past ten years, few exposure studies have been carried out among farmers and growers in the Netherlands.

Research carried out abroad has also uncovered evidence that occupational exposure to plant protection products involves health risks.[96,97]

4.2 Health effects in farmers and growers

4.2.1 Reports and incident investigations

The Committee has few details concerning the number of cases of acute poisoning in farmers and growers. A study by the National Poisons Information Centre in the 1990s showed that there were about 40 cases a year.[98] In two thirds of cases, the incident in question took place during preparation or maintenance, or when working with treated crops. In 2011, the National Poisons Information Centre was consulted over 1,000 times about exposure to plant protection products and biocides.[99] However, it is unclear how much of this involved occupational exposure to plant protection products. Many of the reports involve the private use of biocides. In other countries too, there are occasional reports of cases of acute poisoning among farmers and growers.[100,101]

The Netherlands Center for Occupational Diseases seldom receives reports about cases of occupational disease caused by the use of plant protection products.[102] However, occupational diseases in general are significantly under-reported. In the past, skin disorders among workers in the flower bulb cultivation sector were associated with the use of plant protection products.[103] Skin disorders among farmers and growers, however, are primarily caused by contact with plant juices. Respiratory allergies, too, are mainly caused by natural agents such as plant pollen, mushroom spores, or predatory mites.[82]

4.2.2 *Epidemiological study*

Painstaking epidemiological studies are usually needed to establish relationships between plant protection products and health effects that occur more gradually, or that only manifest after a protracted period of time.

Research in the Netherlands

A relatively large number of epidemiological studies have already been conducted among farmers and growers in the Netherlands. These studies focused on a range of agricultural sectors, a multitude of plant protection products and a wide variety of health effects.

A 1988 study into the neurotoxic effects of plant protection products among bulb growers revealed that those who suffered occupational exposure were significantly slower at processing information and had lower neural conduction velocities than a comparable control group.[88] However, the observed differences were not large, nor did they show any correlation with health problems. Very recent research has also examined the possibility of a relationship between occupational exposure to plant protection products and Parkinson's disease and ALS (amyotrophic lateral sclerosis, a fatal neurological disorder that causes paralysis). The results of that study have yet to be published, but the preliminary results of the Parkinson study have been presented at a symposium. They indicate the existence of a link between the occupational use of herbicides and insecticides, and a slightly increased risk of Parkinson's disease.[104]

Evidence of effects on reproduction has been found in fruit growers. In this group, a link was found between a reduced chance of conception per month (i.e. a longer time-to-pregnancy) and increased exposure to plant protection products on the part of the fruit grower. At least, this was the case if the attempt to establish a pregnancy took place in the spraying season, from March to November.[105,106] At other times, no such effect was found. In greenhouse floriculture, too, there is evidence for a prolonged time-to-pregnancy[107,108] and an increase in the number of spontaneous abortions.[109] There is also evidence that in-vitro fertilisation treatment is less effective in men who have been exposed to plant protection products.[110] Finally, a recent study in the Rotterdam region found that occupational exposure suffered by pregnant women is associated with lower placental weight and reduced foetal growth.[111,112]

Studies in other countries

Other countries have also carried out epidemiological studies into health effects in farmers and growers that might be related to exposure to plant protection products. These studies found associations with an extended time-to-pregnancy,[113] impairment of cognitive abilities,[114] Parkinson's disease,[115-117] ALS[118,119] and various forms of cancer in adults.[120,121] Prenatal exposure and, in some cases, parental exposure before conception, appear to be linked to adverse changes or illness in children. That includes lower birth weight, increased body fat in schoolchildren,[122] an increased risk of cardiovascular disease,[123] the reduced or impaired development of genitals in boys,[124,125] early breast development in girls[126] and cancers in children.[127-131]

The results of foreign studies cannot always be directly translated to the Dutch situation. Nevertheless, the results of studies in the Netherlands and elsewhere are broadly similar. Some of the above-mentioned results on the impact on the offspring of occupational exposure suffered by individuals before or during pregnancy were derived from a recent Danish study.[122-126] In terms of its agricultural practices and climatic conditions, that country is a reasonably good match for the Netherlands. Accordingly, the Committee considers the results of the Danish study to be particularly relevant to the situation here in the Netherlands.

The European Food Safety Authority (EFSA) recently commissioned a systematic and comprehensive literature review of epidemiological studies (published from 2006-2012) into the link between exposure to pesticides (plant protection products and biocides) and various disorders.[132] The authors note that, despite the large number of studies that have been carried out into the effects of occupational exposure, it is not possible to draw any firm conclusions about most disorders. This is a result of the numerous limitations involved (particularly with regard to the characterisation of exposure) and of the heterogeneity of the results obtained. The authors state that significant and consistent associations with exposure to plant protection products have only been found for leukaemia in the children of farmers and growers, and for Parkinson's disease.

In most epidemiological studies, it is impossible to distinguish between the roles played by individual plant protection products (plus biocides). This is because farmers and growers use a wide range of products, often mixed together in the same tank. As a result, the use of different products is often closely intertwined. This makes it difficult to investigate the effects of individual products. In addition, the researchers often do not know in advance which

product they should focus on first. For this reason, such research usually focuses on exposure to plant protection products in general or on specific groups of products. This can create the impression that each individual plant protection product can cause every one of the effects seen. This is obviously not the case. If the associations found are based on a causal relationship, then it is likely that only a limited number of products are responsible for the effect being studied. However, it is seldom clear which ones are involved. Conversely, apparent conflicts between the results obtained from different studies may be due to the fact that the researchers in question were studying different cocktails of plant protection products, without being aware of the exact details.

4.3 Conclusions

Based on numerous epidemiological studies in the Netherlands and elsewhere, the Committee believes that, in the past, health effects occasionally occurred among operators working with plant protection products and among workers handling treated crops. It is difficult to be sure about the scale involved. The Committee considers it unlikely that all of the observed health effects can be ascribed to methodological limitations that may be inherent to epidemiological studies.

Many of the Dutch studies were carried out several years ago. Since then, exposure has been impacted by numerous technological developments in areas such as formulations, packaging, and equipment, and by more extensive instruction and training. There has also been a shift in the range of approved products. Accordingly, the situation may have improved in recent years. However, evidence from the recent Danish study indicates that effects can still occur. The Committee therefore considers it possible that health effects are still occurring in farmers and growers in the Netherlands.

Health effects of this kind among farmers and growers may be due to gaps in the approval procedure. It might be that the toxicological experimental animal studies carried out in support of the approval procedure do not cover all possible effects in humans. In addition, it seems likely that exposure may sometimes be higher than expected, which may account for some of the effects seen in humans. The occupational exposure involved when following the conditions of use may have been underestimated. The recent evaluation of the Policy Document on Sustainable Plant Protection, however, has made it clear that farmers and growers still do not assign sufficient priority to safety in occupational situations, and that there is a poor level of compliance with the conditions of use.[82,84] This is

undoubtedly one of the reasons why occupational exposure in the everyday situation is occasionally higher than anticipated.

In Chapter 3 it was noted that the approval procedure does not devote separate consideration to the risks to those living in the vicinity of agricultural land. In the same chapter, the Committee noted that this group gains some protection by 'hitching a ride' on the protection afforded to those who make occupational use of plant protection products, workers handling treated crops and non-casual occupational bystanders and passers-by. Despite the approval procedure and numerous amenities in the everyday situation, health effects have nevertheless been observed in these groups and their offspring. This is a second argument for conducting a further inspection of the exposure and health of those living in the vicinity of agricultural land.

Chapter 5

Exposure and health of local residents

In this Chapter, the Committee discusses the ways in which those living in the vicinity of agricultural land might come into contact with plant protection products. It covers the design and results of various types of studies into the extent of that exposure. Light is also shed on the research conducted into the health of local residents, in relation to the use of plant protection products in the vicinity. Based on all this data, the Committee gives its assessment of the likelihood that those living in the vicinity of agricultural land will suffer health impairment due to the application of plant protection products in their immediate surroundings. In this way it answers the Ministers' question about the potential health risks posed by plant protection to local residents.

5.1 Exposure of local residents

5.1.1 Sources and pathways of exposure

In Figure 2, the Committee presents a diagrammatic representation of the sources and pathways that could be involved in the exposure (to plant protection products) of those living in the vicinity of agricultural land. The figure makes it clear that a complex interplay of sources and pathways is involved. Obviously, those agricultural operators and workers (and their families) that live in the vicinity of this land will also be exposed via these non-occupational pathways.

Sources and pathways of exposure

Local residents' exposure is complex in nature. Exposure can occur through many different pathways. Moreover, plant protection products don't only originate in fields, but they can also be present in food and in products that people use at home.

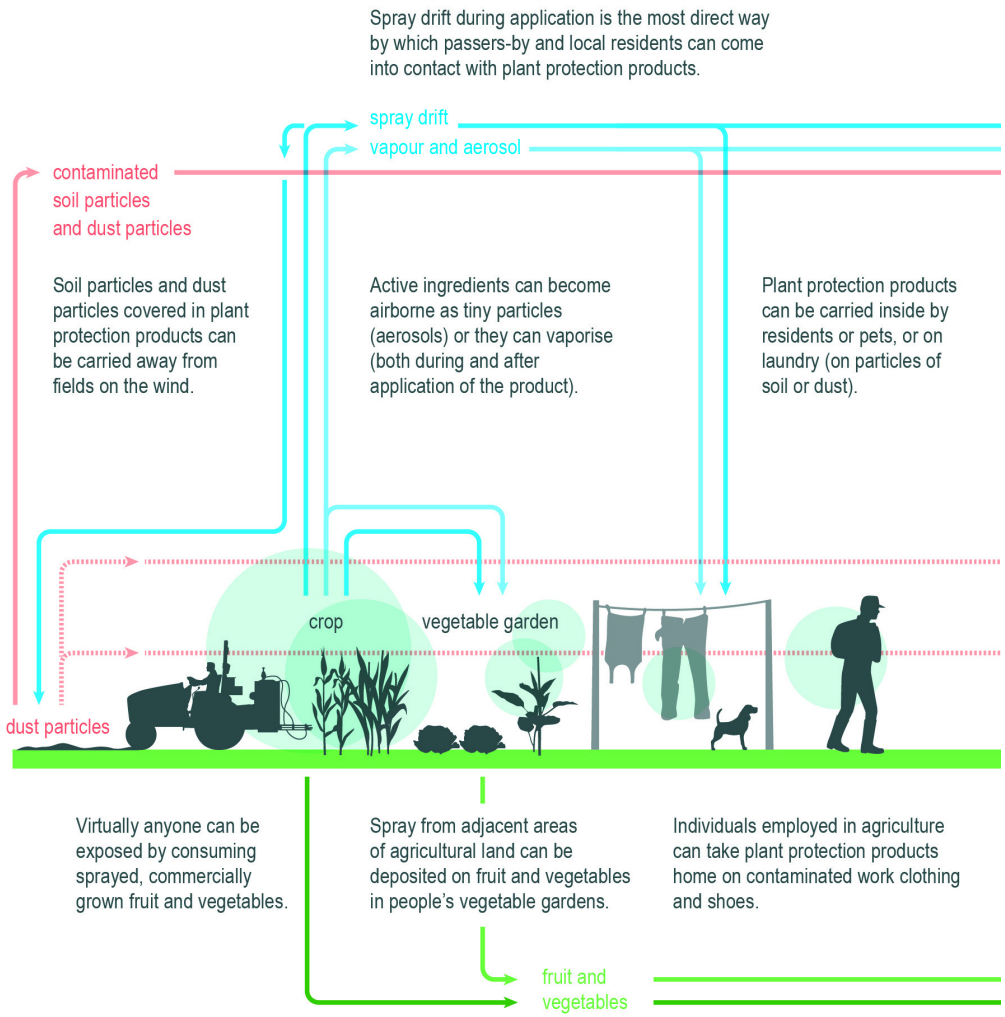
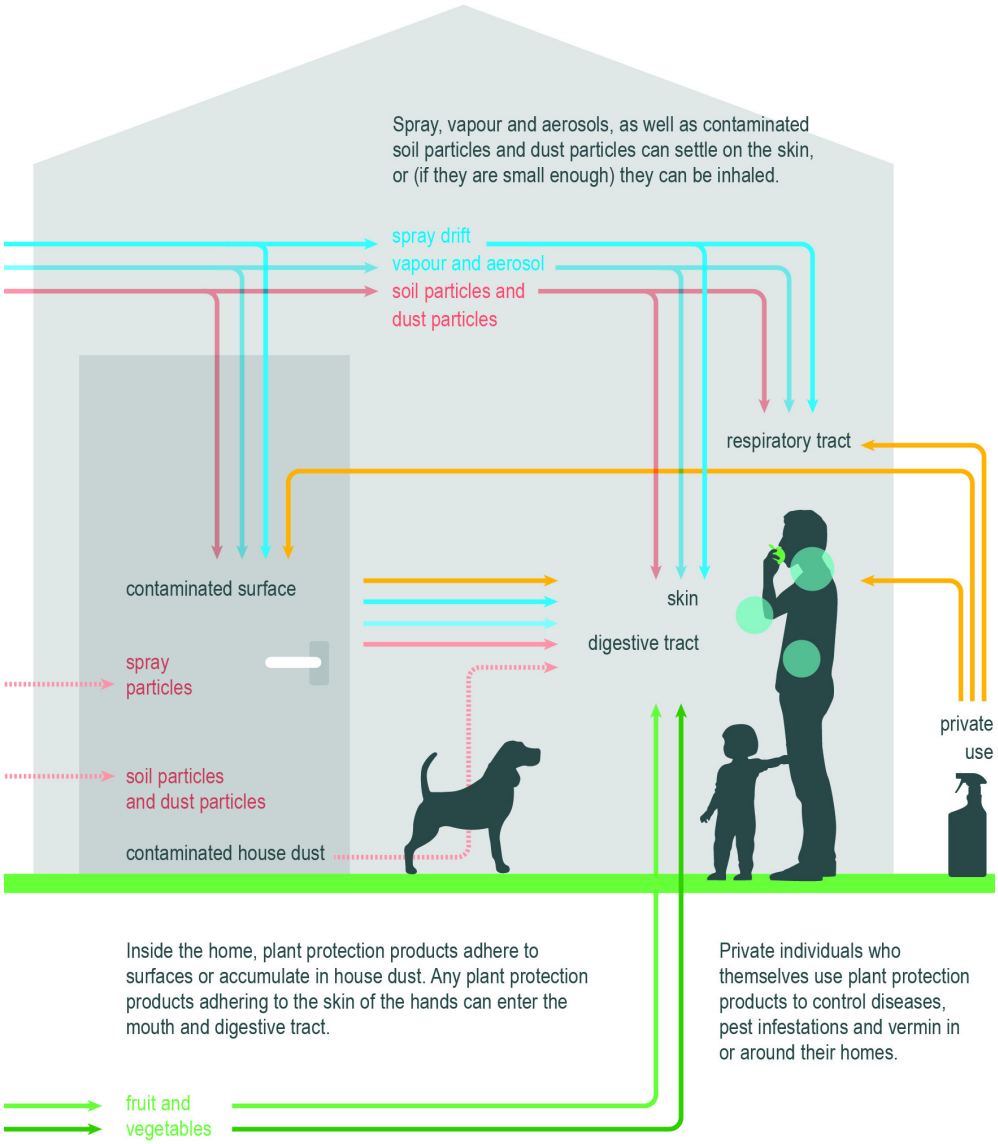


Figure 2 The exposure of local residents to plant protection products is a complex process involving various sources



and pathways.

Some pathways are important to almost everyone. First of all, this involves the consumption of fruit and vegetables which are grown using plant protection products and sold in shops or by growers directly. Furthermore, private individuals themselves can use plant protection products (or biocides or veterinary drugs containing the same or similar active ingredients) to control diseases, pest infestations and vermin in or around their homes.

Direct exposure

In the case of people in rural areas, especially those living near treated land, various other pathways may also be involved. Spray drift during application is perhaps the most direct and visible of these. Accordingly, it is the most familiar way by which bystanders, passers-by and local residents can come into contact with plant protection products. Drops of spray may settle on the skin, after which varying amounts of the substances they contain can be taken up by the body. If these droplets are sufficiently small, they can also be inhaled.

During spraying, active ingredients can become airborne as tiny droplets or particles (aerosols) or they can vaporise from the spray. However, most of this vaporisation takes place on the soil and the crop after spraying has been completed. Vapour may be released following the injection of soil fumigants into the ground. Vapour and aerosols can also be released when greenhouses are ventilated. They can either linger around the application site or they can drift away. They can be inhaled by local residents. However, vapour and aerosols can also bind to skin and mucous membranes. Powdered and granulated plant protection products can produce clouds of dust during application or when the spraying liquid is being prepared. Finally, particles of soil or dust covered in plant protection products can be carried away from fields on the wind. All of these particles can adhere to the skin or, if they are sufficiently small, they can be inhaled.

Indirect exposure

Apart from direct contact with spray, vapour and aerosols, there is also the risk of secondary exposure through skin contact with surfaces that are contaminated with vapour, spray or dust particles. Contact of this kind takes place when local residents, such as children at play, enter treated areas shortly after spraying or walk on lawns contaminated by windblown spray. Another example is swimming in surface water that has been contaminated with plant protection products. In

addition, if contaminated surface water is used to irrigate agricultural land, plant protection products may re-enter the air as spray or vapour, and become dispersed.

People can suffer exposure indoors as well. Vapour, dust particles, and spray can be carried indoors on air currents. The residents themselves can also carry plant protection products indoors, in the form of contaminated dust and soil particles adhering to their clothing or footwear. If one of the residents themselves is employed in agriculture, as an operator or as a worker handling treated crops, then any contaminated shoes and clothing that is taken home will be another exposure pathway. The scientific literature refers to this as the 'para-occupational' or 'take-home' pathway. These substances can also be carried indoors by pets, or on any laundry or bed linen that has been hung out to dry. Inside the home, plant protection products adhere to surfaces or accumulate in house dust. Any plant protection products adhering to the skin of the hands can then enter the mouth and digestive tract. Small children are at particular risk in this regard, as they are much more likely than adults to place their dirty fingers into their mouth. Indeed, small children are much more likely to place objects of any kind into their mouth. These, too, may be contaminated with plant protection products.

Finally, exposure via the intestinal tract can also result from the deposition of spray on fruit and vegetables in private vegetable gardens or by irrigating vegetable gardens with contaminated ditch-water.

The exposure of local residents to plant protection products is not necessarily due solely to the actual application of these products. If performed carelessly, storage, mixing the spraying liquid, cleaning and maintaining equipment, as well as the processing of residues and waste can lead, directly or indirectly, to the exposure of local residents. This is particularly applicable to the children of farmers and growers.[133]

5.1.2 Exposure study in local residents

Various types of studies are being conducted into the exposure of local residents. Some use model-based estimates, while others use measurements in media with which local residents can come into contact, such as air, water, soil and house dust. Other studies use biomonitoring, i.e. the analysis of human tissues or excretory products, such as blood and urine. Each method has its own strengths and weaknesses (see the glossary in Annex I). For this reason, studies sometimes combine several different methods. In the summary below, the Committee lists

the results reported in the scientific literature and in reports issued by various research institutes.

In the Netherlands, a limited amount of research into the exposure of local residents has been carried out since the early 1980s. Most model-based estimates of the concentrations to which local residents may have been exposed, plus measurements in contact media, seem to indicate that exposure to individual substances remains well below the health-based limit values. The same estimates also indicate that individual substances are not expected to produce any health effects.[31-33,134] In a few cases, researchers cannot completely exclude the possibility of risks involving certain substances and some population subgroups.[27,135,136] As far as the Committee is aware, no biomonitoring studies (systematic or otherwise) in local residents have ever been conducted in the Netherlands. However, such studies have been carried out in those who make occupational use of plant protection products[93,137,138] and in the general population.[139] The studies into local residents that were carried out in the Netherlands are of limited scope, in addition to being exploratory in nature and relatively dated. The Committee considers this Dutch data to be too sparse to support firm conclusions.

More extensive studies have been carried out abroad, especially in the US. It is worth noting that the American situation may differ significantly from that pertaining in the Netherlands. Such differences include the size of agricultural holdings, the size of cultivated plots of land, the intensity of agriculture, spatial planning (distance to housing) and climate. Although the results are not always consistent, a few general patterns have emerged. The highest levels of plant protection products in house dust and on surfaces are found in the homes of farmers and growers themselves.[140-144] This is particularly true where the farmers/growers themselves are the operators, and slightly less so where they are the workers handling treated crops.[145] Research here in the Netherlands confirms the presence of elevated levels of plant protection products in farmers' homes.[31,32] In this connection, however, the Committee notes that, despite the use of sensitive analytical techniques, a significant proportion of the samples taken from people's homes (including those of farmers and growers) were found to contain no detectable traces of plant protection products.

Numerous urine analyses have shown that occupational exposure to plant protection products is usually one to several orders of magnitude greater than non-occupational exposure.[87] In line with this, US measurements have also revealed the presence of elevated levels of plant protection product metabolites in the urine of farmers and growers.[143,146,147] In farmers and growers who hire contractors to apply the products, rather than doing this work themselves, these

levels are not elevated.[146] The concentrations of metabolites in the urine of farmers and growers are closely related to those found in the urine of their partners and children.[147-149] These are often elevated too[143,147,150,151] but this is not always the case[145,147,152,153]. Analyses of house dust and surface wipe samples, distribution between the various rooms in the house, analyses of dust samples from footwear and vehicles, plus wipe samples from the hands of children, indicate that farmers and growers themselves contribute to the elevated exposure suffered by the members of their family and other members of the household, via the 'take-home' pathway.[144,147-149] This phenomenon is also seen in other industries where chemicals are processed.[154-156]

Analyses indicate that the residents of rural areas who do not themselves work in the agricultural sector have lower exposures than farmers and growers and their families. However, very few comparisons have been made with the residents of non-agricultural areas. In terms of the metabolites of organophosphate insecticides in their urine, adults and children in urban areas of Seattle had similar levels to those found in the residents of rural areas in the state of Washington.[157,158] It is worth noting, however, that Americans tend to use relatively large quantities of plant protection products and biocides in and around the home, to control pest infestations. However, a product like azinphos-methyl (an organophosphate insecticide that in the study area, the state of Washington, is only used in agriculture) is found in the house dust of every home in agricultural areas, including those of non-farmers.[140] This is consistent with findings here in the Netherlands, where plant protection products have been found in the homes of non-farmers/growers who have not applied any products.[31,32] This indicates that at least some of the exposure suffered by local residents comes from treated land. It is not known how much is brought in by air, nor what quantities of these substances are brought in by the residents and their pets. That probably varies from one product to another.

Studies in agricultural areas do not always find a clear correlation between the levels of metabolites in urine and the quantities of their parent compounds in house dust.[147,151] One explanation is that modern plant protection products are rapidly metabolised and excreted by the body. However, the relative absence of UV radiation, combined with the dry conditions inside homes, can reduce the rate at which these products break down in house dust.[159,160] Accordingly, the levels of these products in house dust better reflect their use in the surrounding area over a longer period of time.[142] A second reason is that urine concentrations are partly determined by other sources and exposure pathways.

The relationship between the levels of plant protection products in house dust or urine samples and the distance to treated land reveals a very mixed picture.

Clear correlations are sometimes found (significantly higher concentrations at decreasing distances).[150,151] In other studies, distance appears to be a relatively minor factor.[143,148,149,152,153,161,162] The only study conducted in the Netherlands into levels of plant protection products in house dust was exploratory in nature and too limited in scope to support any conclusions about a relationship with the distance to the field.[31,32] Distance bears no relationship to other relevant factors, such as the quantity of plant protection product applied, the application method used, the area treated, and the weather conditions (e.g. wind direction) during and after application. In light of this, it is hardly surprising that there are inconsistencies in terms of the presence of agricultural plant protection products in homes. Urine levels can also be affected by other sources, such as people's diet.

In many of the biomonitoring studies cited, urine samples were taken and analysed at just one or two fixed times. In many cases, no details were given of the relationship between the times at which these samples were taken and the times at which spraying operations were carried out. If samples are taken at the wrong time, this can result in an underestimation of exposure.

Studies yield more readily interpreted results if sampling is precisely matched to the timing of spraying operations. Sampling before and after the aerial spraying of a potato field in the US revealed elevated levels of the plant protection product in question, immediately after spraying. It was found in wipe samples of playground equipment in the open air, in wipe samples taken from children's hands, and in the urine of children who were in the vicinity.[163] One day later, all of these levels had dropped significantly. In children, there was a close correlation between the time that they spent playing outside after spraying had been completed and the concentration of plant protection product in wipe samples taken from their hands, and in their urine samples. This illustrates the importance of collecting information about the activity patterns of the individuals involved.

The existence of seasonal trends was revealed by a study in a smaller group of individuals, in which urine samples were taken repeatedly, over a longer period of time. People living in rural areas were found to have higher urine concentrations of commonly applied products in the spraying season than at other times.[152]

The scarcity of information in the scientific literature about the absolute and relative importance of the various sources and pathways of exposure gives rise to considerable uncertainty.[87] Both are very likely to be both substance specific and environment specific. This is illustrated by a study that was carried out in California. This study of exposure in young children (of farmers and growers)

employed a model that has been validated by - and used to process - numerous measurements.[164] In the case of one particular insecticide, the researchers calculated that dietary exposure was slightly greater than exposure from ingested house dust or from finger sucking. In another insecticide, however, the reverse seemed to be the case. It also seemed that there were differences between different age groups. In babies, exposure by finger sucking was higher than in toddlers. The latter group exhibited higher dietary exposure.

Some researchers have compared the estimated or measured exposure with health-based limit values. They have concluded that exposure to one of the insecticides studied, from all pathways combined, is so high that children in the rural study area in question are at increased risk of health impairment.[164,165] Others report that the general population's exposure to the herbicides they have studied is unlikely to pose a risk to health. The same applies to the members of agricultural workers' families and to those living near the application sites.[165,166] However, comparisons of this kind involve the use of conversions. They are usually fraught with considerable uncertainty, especially those that are based on a small number of measurements over time. They are mainly useful for prioritising further research.

Finally, the Committee would like to point out that studies carried out abroad have relatively little bearing on potential exposure levels and health risks here in the Netherlands. Nevertheless the exposure pathways are probably the same, and in that sense studies carried out abroad are indicative of potential issues in the Netherlands. However, the absolute and relative importance of the various individual pathways in the US undoubtedly differs from the situation in the Netherlands. The American landscape is much larger, the distances are greater and climatic conditions vary. Agricultural practices are also different. Aerial spraying, for example, is not permitted in the Netherlands (with some exceptions). However, the level of product use in some types of crops in the Netherlands is particularly high. In addition, many of the studies carried out abroad involved products that have never been approved (or are no longer approved) here, or that were not approved in this country for the same pest in the same crop. Given the lack of relevant information on exposure, it is impossible to say with any certainty whether environmental exposure poses a genuine risk of health impairment to local residents in the Netherlands. However, the studies carried out in other countries can provide valuable information on how to set up an exposure study here in the Netherlands.

5.2 Health effects in local residents

All of the studies into possible health effects in local residents were observational in nature. The researchers involved took no action to modify people's exposure to plant protection products, nor did they conduct any experiments to this end. A distinction must be drawn between the study of reports and incidents in which the health of local residents is at stake and systematic epidemiological studies into the possible health effects of generally chronic exposure. In the latter case, researchers compare local residents' health status and exposure to those of control populations.

5.2.1 Reports and incident investigations

Medical practitioners treating cases of acute poisoning in humans and animals can consult the National Poisons Information Centre (NVIC). The Centre issues an annual review of these consultations. In 2011, there were 51,000 reports of exposure to potentially toxic substances. Approximately two percent of these reports (more than 1,000 in all) involved the category of 'pesticides and disinfectants'.[99] Based on this annual review, it is not possible to determine how many reports involved people living in the vicinity of agricultural land, who had been exposed to locally used plant protection products. The nature of the reported substances (mould removers, herbicides, algaecides, insecticides in bait boxes and sprays) suggests that most of these incidents involve careless use by individuals themselves.

Every few years, the National Institute for Public Health and the Environment (RIVM) reports on environment-related questions and complaints submitted to municipal health services. The third survey, about 2009 and 2010, shows that the municipal health services recorded 5,800 environment-related questions and complaints during this period.[167] About one quarter of the complaints involved the outdoor environment. Approximately thirty (2 percent) of those complaints were linked, by those who submitted them, with the agricultural sector. Of these, one was related to flower bulb cultivation, four to greenhouses, eleven to agriculture, and sixteen to intensive livestock farming. Sixteen complaints involved 'pesticides'. The numbers and nature of these complaints were not significantly different to those listed in the 2004-2006 and 2008-2009 inventories.

The Committee is also aware of two incidents, in the Zeeuws-Vlaanderen (2008) and Westland (2011) regions of the Netherlands, in which at least ten

local residents became ill or suffered irritation of the eyes or respiratory system. The cases in the former region involved soil fumigation in lily cultivation,[168] while the latter may have involved the release of an insecticide from a greenhouse.[169] Weather conditions were thought to have played a major part in both cases.

At the hearing held by the Committee, and thereafter, several of those living in the vicinity of land used for agricultural and horticultural purposes reported health problems that they associated with the use of plant protection products on adjacent areas of land. This mainly involved nausea, as well as irritation of the eyes, lips and upper respiratory tract. One of the reports resembled the above-mentioned incident in Zeeuws-Vlaanderen.

The Committee has no clear idea of how frequently local residents experience health problems and link these to the use of chemical plant protection products. The above-mentioned records show that there have only been a small number of questions and complaints about these products. However, it is possible that the numbers involved may have been under-reported. Caregivers will not always feel it necessary to consult the National Poisons Information Centre. Nor will local residents always contact the municipal health service. Under-reporting is particularly likely in the case of mild symptoms. Overexposure to various plant protection products is known to cause nausea or irritation. Farmers and growers are warned about this, and they can protect themselves by using personal protective equipment. In the case of symptoms suffered by local residents, investigations into the nature and level of exposure involved rarely, if ever, take place. This makes it difficult (or more difficult) to establish any causal relationships to the use of plant protection products. The fact that further investigations almost never take place suggests that these cases almost always involve less severe, reversible health effects. Other countries have also reported incidents caused by spray drift created when applying plant protection products.[170]

5.2.2 *Epidemiological study*

Few epidemiological studies have been carried out into the possible health effects of chemical plant protection in those living in the vicinity of agricultural land, horticultural land or greenhouses. The majority of such research focuses on the families of farmers and growers. In general, observational epidemiological studies fall into one of four categories: ecological studies, cross-sectional studies, case-control studies, and cohort studies (see Annex I).

Ecological studies operate at the level of entire populations. They compare the health of people in areas associated with certain types of plant cultivation (a crude yardstick for exposure to plant protection products) to the health of those in control areas, where no such cultivation takes place. Such studies are of limited validity, as comparisons at group level can bias the results in many different ways. For example, no distinction can be drawn between occupational exposure and environmental exposure. Aside from the types of plant cultivation in question, other differences between regions might also account for any associations. Studies of this kind are, at best, only useful for generating hypotheses.

A cross-sectional study is a type of epidemiological study in which the participants' exposure and health status are determined at the same point in time. In case-control studies, patients with a particular disorder are compared to control subjects, in terms of their respective exposures. Differences in exposure suggest a possible link between such exposure and the disease in question. In cohort studies, exposed individuals are compared to control subjects who have suffered little or no exposure, in terms of their respective medical histories. The latter type of study delivers the strongest evidence. In these three types of epidemiological study, information is readily available about the disorders, about possible risk factors and, to a greater or lesser extent, about the exposure (to plant protection products, in this case) involved at the individual level. Studies of this kind are much less susceptible to the above-mentioned confounders than ecological studies. An important consideration with epidemiological studies is that, in the majority of cases, the focus is not on the effect of a single product. In most types of plant cultivation, individuals are, by definition, exposed to a range of different products. It is often impossible to trace any association to individual products.

The main findings of epidemiological research conducted among local residents, per disease or disorder, are summarised below by the Committee. Where necessary, it has added various comments regarding the methodology involved.

Effects on the unborn child

In recent years, various cross-sectional and cohort studies have revealed an association between prenatal exposure to certain insecticides (determined by analysing cord blood or the urine of pregnant women) and structural abnormalities in the brain[171] or impaired cognitive ability[172-174] in children aged six to eleven. Only one of these studies took place in an agricultural area,[173] and

none of them has provided any information concerning the origin of the insecticides in question, or about the contribution made by the environment. The products might also originate from occupational exposure suffered by the parents, from the diet, or from pest control in the home. While the above-mentioned studies may give an indication of the toxic potency of these compounds, they shed little light on the risks of living near agricultural land.

A number of epidemiological studies have focused more specifically on this question. The results obtained suggest the existence of a link between the use of plant protection products in agriculture and horticulture in the vicinity and effects on the health of the unborn child. One systematic review examined 25 original studies (published from 1950 to 2007) into the potential adverse effects (on reproduction and the offspring) of living near places where plant protection products are used. The review's authors concluded that there is weak evidence for a link between exposure to plant protection products and congenital abnormalities.[175] Due to methodological limitations (such as problems in accurately characterising exposure and possibly inadequate correction for confounding factors), however, firm conclusions are still out of reach. According to the authors, the evidence for a link to other adverse effects (stillbirth, growth retardation in utero, low birth weight, premature birth and miscarriage) is, at the very least, dubious. Nevertheless, the authors feel that further research is called for, the main aim being to improve the characterisation of exposure.

The review article is not entirely up to date, as a handful of studies have been published since then.[176-179] This new work has similar methodological limitations to its predecessors. Furthermore, in the Committee's view, it does not affect the conclusions reached in the above-mentioned literature review.

Cancer

A few ecological studies carried out in the United States and Europe have explored the relationship between different childhood or adult cancers and the agricultural use of plant protection products (or the presence of certain types of crops) in the immediate living environment.[28, 180-185] In some instances, researchers have found an association between the occurrence of certain cancers and people living in regions where there is intensive agricultural activity or where intensive use is made of plant protection products at the time of diagnosis. In other cases, no such association was found. As previously mentioned, the design of ecological studies imposes a number of limitations. Being a resident in a given local authority area or in some other administrative unit is a very crude indication of the level of actual exposure involved. Furthermore, no account can

be taken of confounding influences, such as differences in lifestyle at the individual level. Nor is it possible to distinguish between occupational exposure and environmental exposure. In addition, given the large number of statistical comparisons between different forms of cancer and various types of plant cultivation or products, any associations found may be coincidental to some extent. Whenever researchers engaged in studies of this type observe associations, they invariably claim that further research is needed in order to interpret the results.

A few case-control studies have also been conducted among local residents, on both sides of the Atlantic. Most of these focused on leukaemia and lymphomas in children and young adults.[16,186-189] These studies found a more or less clear correlation with the use of certain plant protection products (or groups of such products), or with the presence of certain types of crops near the child's home or that of the mother during her pregnancy. However, no clear dose-response relationships could be identified. The relatively crude characterisation of exposure used meant that these studies, too, were unable to reach any firm conclusions. For example, the possibility cannot be excluded that these were the children of parents who were occupationally exposed to plant protection products or that pest control took place in or around their home. Furthermore, in some studies, corrections could not be made for other risk factors, such as exposure to other chemicals.

A few case-control and cohort studies focused on the relationship between various cancers in adults and exposure to chemical plant protection products originating from the agricultural environment. These included bladder cancer,[190] prostate cancer,[191] and breast cancer.[192,193] The prostate cancer study was the only one to demonstrate an association with the use, in the vicinity, of certain products, namely those with a plausible biological role in the carcinogenesis of the prostate.[191] Neither of the breast cancer studies found a clear association with the use of plant protection products in the environment, either by the women themselves or by their partners. One of the studies[193] did find evidence of an increased risk associated with a few individual products. However, as the researchers themselves pointed out, in the absence of additional data no firm conclusions can be reached. Furthermore, that study identified a slightly higher risk of breast cancer in women whose homes were situated closest (within 90 metres) to the application sites. In all of the above-mentioned studies, exposure estimates were based either on information about the types of crops in the vicinity of homes and the associated use of chemical plant protection products, or on information from questionnaires on substance use completed by the participants themselves.

Parkinson's disease

In a recent review article and meta-analysis of 46 original studies, the authors conclude that there is a clear association between exposure to plant protection products (especially herbicides and insecticides) and Parkinson's disease in operators.[116] The relationship is particularly clear with regard to occupational exposure and, to a lesser extent, with exposure through private use. The researchers cannot, therefore, exclude the possibility that those making personal use of such products are at increased risk of this disease. However, a recent case-control study carried out in a rural area of California suggests that even those who make no use of such products are at increased risk, possibly due to exposure originating from their agricultural living environment or working environment.[194,195] Exposure estimates were based on figures for the use of plant protection products and on information about land use in a radius of 500 metres around people's home and business addresses. Prolonged exposure from an early age and exposure to combinations of a few specific herbicides and fungicides, in particular, were thought to lead to an increased risk. Incidentally, no correction was made for exposure to other products. In the Netherlands, Utrecht University's Institute for Risk Assessment Sciences (IRAS) is currently investigating the relationship between exposure to plant protection products originating from the environment and the risk of Parkinson's disease. The results of this work will probably not be available for another year.

5.3 Conclusions

The Committee notes that, in the Netherlands, little research has been conducted into the exposure and health status of those living in the vicinity of agricultural and horticultural land, in relation to the use of chemical plant protection products. Accordingly, the Committee must, of necessity, base its judgment of the health risks to local residents mainly on research carried out abroad (mostly in the United States).

The general population's exposure to plant protection products is usually significantly lower than that suffered by those who, by virtue of their profession, have to deal with these products. In most cases, the same is probably true of local residents. Research has indeed shown that local residents can be exposed to plant protection products that originate from their agricultural environment. Based on the available data, it is not possible to accurately estimate the importance of this source compared to other sources of exposure (diet, domestic use in and around the home), especially in terms of the Dutch situation. The exact contribution

involved will, undoubtedly, vary from one product to another. The same applies to the importance of the various exposure pathways from the agricultural environment. With regard to less-volatile products, contaminated clothes and shoes appear to be a major pathway, in quantitative terms. This is supported by the fact that the members of farmers' and growers' households tend to suffer greater exposure than those in the households of people in other professions, living in the same area. If the measured or estimated exposure suffered by local residents is compared to health-based limit values, in some cases (especially in small children) these values appear to have been exceeded. However, comparisons of this kind are fraught with great uncertainty.

Outside the Netherlands, epidemiological studies into possible health effects in local residents often reveal links between exposure to plant protection products originating from the agricultural environment and the occurrence of certain disorders. These include effects on the unborn child, childhood leukaemia and Parkinson's disease. However, this kind of study among local residents is subject to all sorts of methodological limitations. In particular, the nature, extent and source of exposure are often inaccurately characterised. The researchers themselves usually note that it is not possible to draw any firm conclusions and that further research is needed. Moreover, these epidemiological studies in local residents are limited in number and diverse in nature (covering a wide range of cultivation situations and disorders). As a result, it is impossible to say, with any degree of certainty, whether there are any consistent, causal relationships between certain diseases and the proximity of certain types of crops. Nevertheless, the limited findings in local residents are in keeping with the effects seen in those who are exposed while making occupational use of such products.

It is difficult to translate these findings into potential exposure levels and health effects here in the Netherlands. While the exposure sources and pathways are likely to be the same, this cannot be said of their absolute and relative importance, due to the different circumstances pertaining here in the Netherlands. Nevertheless, the Committee feels that the results of studies in other countries are sending a signal that, in the Netherlands too, chemical plant protection may cause health effects in those living in the vicinity of agricultural land. Still the Committee suspects that the risk involved is low compared to that posed to occupationally exposed individuals. Furthermore, in agricultural areas of the Netherlands, local residents occasionally complain of short-term symptoms such as nausea, or irritation affecting the skin, eyes or upper respiratory tract. A number of products are known to induce complaints like this, at sufficiently high levels of exposure. Only very rarely is the possibility of a link

to exposure investigated, however. In view of this, the Committee takes the view that exposure studies conducted among those living in the vicinity of agricultural land here in the Netherlands are certainly useful. Research conducted elsewhere is a useful source of information concerning the design of studies like this.

Chapter 6

Usefulness and design of studies conducted among local residents

In the present Chapter, in response to the request from the Ministers, the Committee conducts a closer examination of the usefulness and possible design of a study among those living in the vicinity of agricultural and horticultural land where chemical plant protection products are applied. Studies of this kind can provide an insight into the health risks to local residents, as well as further information on the necessity and effectiveness of measures to reduce exposure.

6.1 The usefulness of studies conducted among local residents

Given the observed health effects in farmers and growers themselves, coupled with some evidence of effects in local residents from studies conducted abroad, and a lack of data from this country, the Committee feels that there is sufficient reason to conduct further studies among local residents in agricultural areas of the Netherlands.

6.1.1 Exposure study first

In their request for advice, the Ministers for Agriculture requested the Health Council's opinion concerning the usefulness and design of a study among those living in the vicinity of agricultural land where plant protection products are applied. In its advisory letter of 2 September 2011, the Council stated that a distinction must be made between an exposure study and health research, and

that the former should be carried out first (see Annex C).[7] Indeed, a more detailed knowledge of exposure is indispensable if any health effects in local residents are to be related to the use of plant protection products in the vicinity. Based on the results of the exposure study, a decision can then be taken about whether health research would be useful and, if so, what form it should take. There has been no change whatsoever in the Committee's stance on this matter.

6.1.2 *Combination of research methods*

Several different research methods can provide insight into human exposure to chemical substances. These include model-based calculations, measurements in 'contact media' (such as air, water, soil, house dust) and internal measurements of human tissues or excretory products (such as blood or urine) (see also Annex I). They each have their own strengths and weaknesses. In the Netherlands, only a limited number of measurements have been made of the external exposure (to chemical plant protection products) suffered by those living in the vicinity of agricultural and horticultural land. To the best of the Committee's knowledge, this group's internal exposure has never been studied. Data of this kind is also scarce in other countries, with the possible exception of the United States. Moreover, differences in landscape, climate and agricultural practices mean that this data cannot be directly translated to the Dutch situation.

The Committee believes that research carried out here in the Netherlands will help to fill the knowledge gap. It also feels that an approach in which the various research methods are combined offers the best guarantee of reliable and interpretable results. In theory, the measurement of internal exposure (biomonitoring) is to be preferred in situations where an agent's sources, dispersion behaviour or exposure pathways are either diverse or not well understood.[196,197] That is the case with the exposure of local residents to plant protection products (see Section 5.1 and Figure 2). In such cases, it is not enough simply to measure external exposure by the analysis of contact media, due to the risk of relevant exposure pathways being overlooked and of exposure being underestimated. Internal exposure is a better indicator of the entire burden from all exposure pathways. Moreover, unlike external exposure, internal exposure to harmful agents is more directly linked to possible health effects.[196] Several years ago, various government agencies in the UK also recommended the use of biomonitoring in local residents.[39-41] Accordingly, in 2011 and 2012, biomonitoring studies were conducted among local residents.[9] The results are expected in the course of 2014. While these are certainly of interest to many in

the Netherlands, the circumstances here are nevertheless sufficiently different to warrant a separate study in this country.

The British study measured only internal exposure, not external exposure. According to the Committee, this 'stripped-down' approach has a major drawback, as it provides little information about the sources and exposure pathways of the plant protection products (or their metabolites) found in urine. That is precisely what people want to know (see also Chapter 2). This information is needed to refine the exposure models used in the approval procedure. It is also needed to evaluate the requirement for, and effectiveness of, exposure reduction measures. If the Dutch study is also restricted to biomonitoring alone, and if it finds unexpectedly high concentrations of plant protection products in urine, then their origin will remain unclear. In this event, the study would have to be expanded and repeated. A scenario of this kind is not totally imaginary. A study in the Netherlands found higher levels of organophosphate insecticide metabolites in the urine of pregnant women in Rotterdam than had been reported in other countries. The source of the insecticides in question is entirely a matter of conjecture.[139,198] For this reason, the Committee considers it useful to combine biomonitoring with measurements in contact media and to gather additional information on factors that may affect exposure (such as the nature of application, the distance between homes and treated land, local residents' behaviour, and the weather conditions).[Compare40]

6.1.3 Conditions for studying internal exposure

Responses to the September 2011 advisory letter, including those expressed during the stakeholders' hearing, have made the Committee aware of a widely felt need for a biomonitoring study here in the Netherlands. Some groups of local residents have been demanding a study of this kind for many years. The agricultural sector, distributors and manufacturers, too, hope that this study will finally be able to clarify the situation. "The numbers do not lie", as someone said during the hearing. The Committee points out that a study of internal exposure will only be meaningful if it meets certain criteria (see Box 1). The Committee believes that it is possible to design a study capable of meeting these criteria.

Box 1 Conditions for a meaningful study of internal exposure[196,197,199]

Conditions:
- the internal 'exposure indicator' must be sufficiently specific to the external source (or sources)
- the elimination half-life must be sufficiently well understood for the optimum moment for sampling to be determined
- the exposure indicator should be present in easily accessible tissue
- there must be no contamination or loss during sampling, transport and storage
- the method of analysis to be used must be sufficiently specific and sensitive
- reliable reference data or a good control group should be available.

Other aspects to be taken into account:
- technical and organisational feasibility
- support among stakeholders for participation
- a favourable balance of advantages and disadvantages for the individual or group
- embedding in research into external exposure

6.1.4 Concerns associated with the measurement of internal exposure

The Committee considers it very likely that traces of plant protection products used in the area will be found in the blood or urine of local residents, provided that the analytical methods employed are sufficiently sensitive. Sooner or later, many of the chemical substances used in society will end up in the human body. Plant protection products are by no means unique in this respect. Plasticisers from plastics, flame retardants in electronics, Teflon residues from non-stick coatings in cooking pans, heavy metals from pipes, and paint residues are just a few examples. They are all present in our bodies.[47,48,200-202] The knowledge that a given plant protection product (or one of its metabolites) has been detected in their blood or urine, can cause concern to the individuals in question. The Committee feels that not taking measurements, in an attempt to spare people's feelings, is not an option. Moreover, this might cause local residents to suspect

that there is something to hide.[203] Thoughts like that can evoke just as much anxiety.

According to the Committee, it should be clearly explained to local residents, in advance, that this is not about the presence of plant protection products, as such. It is the levels at which they are present that determine the extent to which these products might be hazardous to health. After all, the body is capable of converting and excreting harmful substances to some extent. The levels measured must be compared to health-based limit values (ARfD, ADI and A(O)EL), before they can be interpreted in terms of health risks. Various calculation methods, such as biomonitoring equivalents, have been developed in recent years to facilitate comparisons of this kind.[166, 204-206] These are health-based limit values for substances in biological samples (such as urine or blood). Based on knowledge of the kinetics of the substance in question, they are derived from known health-based limit values such as ADI or A(O)EL. While the results are fraught with uncertainty, they can be used to determine which plant protection products most merit a closer look.

6.1.5 What results might an exposure study deliver?

Depending on the scope of its design, and provided it is conducted with all due care and attention, an exposure study can deliver the following information:

- Information about the external and internal exposure of local residents to plant protection products in everyday situations. This can be used to check whether the estimate of exposure used in the approval procedure is a realistic approach, in terms of a worst-case exposure scenario in practice, and whether specific components need to be adjusted.
- Information about possible health risks, by comparing measured exposure levels with health-based limit values such as ADI, ARfD and A(O)EL. This information can be used to determine whether follow-up tests for health effects in local residents would be useful, and, if so, which of these effects it would be best to examine.
- Information about the relative importance of the various sources and exposure pathways (see Figure 2 in Chapter 5). This can be used to determine whether the additional sources and pathways by which local residents are exposed to plant protection products are of significance compared to other sources and pathways, such as their diet. This information is needed to assess the effectiveness of measures in the approval procedure, in agricultural practice and in compliance. Such measures involve modifying the models used to estimate exposure in the approval procedure, no-spray zones in

various types of crops, and personal risk control options for local residents (see Chapter 7).

An exposure study has the additional benefit of meeting the concerns of local residents as well as the need for greater clarity expressed by farmers and growers, and by the distributors and manufacturers of plant protection products. In addition, an understanding of the levels of plant protection products (and their metabolites) in our bodies can help to increase awareness of the fact that many of the chemicals we use ultimately end up in body tissues. This awareness can act as an additional incentive for restraint, care and thrift. It can also provide an incentive for the current policy commitment to integrated plant protection (see Section 3.3).

6.1.6 Under what circumstances is it useful to carry out follow-up research?

Follow-up research into health effects can be useful if a certain percentile (determined on a policy basis) of the exposure levels of one or more plant protection products is found to be close to, or above, health-based limit values. In this connection, the Committee is at pains to point out that health effect studies possibly involve even greater difficulties than exposure studies. Such studies take many years, especially if they are prospective in nature. Furthermore, it is not certain that they will reveal any effects, even if these actually occur. It should be noted that the results will not necessarily put an end to the debate about health effects. The Committee therefore considers it prudent to take additional exposure reduction measures (in addition to the measures listed in Chapter 7, which are always worthwhile) when health-based limit values are exceeded, rather than waiting for the results of epidemiological studies into health effects. After all, it is a logical consequence of the approval procedure for plant protection products that exposures in excess of health-based limit values are politically undesirable. If, on the other hand, exposure is found to be well within the limit values, then there is every likelihood that the risk will be within accepted limits. In such cases, from the perspective of local residents' health, no additional measures are required.

6.2 Possible design for the exposure study

Exposure studies require a great deal of effort, especially those that include a determination of internal exposure. In the past, studies of this kind often generated results that were either contradictory or difficult to interpret (see

Chapter 5). Only the most meticulously designed study can deliver useful information, and that requires thorough preparation. This was also evident in the interview with British researchers who are conducting a study of this kind in the UK.[9] The types of crops and the substances to be measured must be selected, analytical methods must be explored or developed, measurement sites, experimental and control populations must be selected, participants must be recruited, staff must be recruited and trained, systems must be developed for the reliable recording and handling of large numbers of samples, storage capacity must be arranged, et cetera. All this takes time.

The Committee does not feel that its mandate extends to drawing up a detailed research protocol. If policymakers and politicians decide that an exposure study actually needs to be carried out, and when they have formulated their goals, then it will be up to the research institute (or a consortium of institutions) to draw up a suitable protocol. The Committee advises the researchers involved to acquaint themselves with the British study protocol.[9] Here, the Committee has restricted itself to a few general comments regarding design.

6.2.1 *Which plant protection products?*

The Committee has not indicated which products should be included in the study. The lessons learned in the United Kingdom show that, based on previous seasons, it is not always possible to predict which products will be widely used in the coming growing season. It is important to ensure that the study does not focus on those products that are hardly used at all during the sampling season. In accordance with the advice offered by the British researchers, the Committee recommends that the plant protection products be selected in close consultation with agronomists who are best placed to know which products will be used in the various crops during the upcoming seasons. The Committee simply mentions some of the criteria on which, in its view, the selection should be based:[207]

- Volume of use (in kg/ha/yr or kg/yr): this determines the level and duration of exposure.
- Toxicity (expressed as health-based limit values such as A(O)EL, ARfD and ADI): there should be a special focus on those products that are known to have the capacity to impair the development of the unborn child or of young children.
- Volatility: by contributing to the substance's ability to leave the application site, this helps to determine the level and duration of exposure.

- Application method used: by contributing to the substance's ability to leave the application site, this too helps to determine the level of exposure.
- Breakdown rates in the various relevant media (soil, house dust, air, water): together these help to determine the level and duration of exposure.
- Hydrophobicity: this determines such things as how strongly a product adheres to soil particles and how readily it is absorbed through the skin, which in turn determine the level and duration of exposure.

In the British study, the choice of which plant protection products to investigate was severely limited by the availability of information on the kinetics of products in the human body (which conversion products form in the body and how are they excreted?). Another limiting factor in this respect was the availability of analytical methods for parent compounds and major metabolites that could be used to measure large quantities of samples.[9] However, the Committee feels that the availability of analytical methods should not be a decisive factor in determining which plant protection products should be investigated. That choice should be dictated primarily by the exposure and health risks involved, as estimated on the basis of the above criteria. In the event that nothing is known about the selected products' metabolites, or if there are no suitable analytical methods, then these deficiencies must be rectified as a matter of urgency. There is the option of storing samples for later analysis, when the requisite knowledge and methods are available. The Committee recommends that the Netherlands should launch a further debate, within the EU, about whether the approval dossier provides adequate guarantees concerning the details of a product's kinetics in the human body. This information is essential to the development of a biomonitoring equivalent for the product in question. In addition, details of the methods used to analyse human blood and urine should be a standard feature of the approval dossier submitted by manufacturers. To date, however, this has not always been the case.

The Committee considers it advisable for the study to focus on an adequate number of plant protection products. The figure it has in mind is ten. If the study investigates too few products, it would be difficult to know for sure whether these substances are sufficiently representative of the entire range of products that might pose a health risk to local residents. Studies involving several different products can also help to determine which of the above criteria are most important in terms of the risk to local residents. Such knowledge is extremely useful in the context of product approval assessments. Moreover, the data obtained in studies of this kind could be used to refine exposure models and to assess the effectiveness of various measures to reduce exposure. It is doubtful

that a mere handful of substances would be sufficiently representative for this purpose. One added advantage is that this approach gives a better understanding of combined exposure. At this stage, the Committee feels that there is no point in investigating more than ten, well-chosen products. To do so would involve much greater expense, or it might exclude more profound lines of enquiry. The Committee believes that it is better to investigate a few products thoroughly than to explore many of them superficially. Based on the results obtained, a decision can be taken at a later date about the value of including additional products.

6.2.2 *Which crops?*

During the hearing, participants expressed the wish that several different types of crops be measured. This is to avoid a situation in which the debate about the exposure suffered by local residents has to be repeated for each individual type of crop. The Committee endorses this standpoint. It feels that the best approach is to select those types of crops that are characteristic of the Netherlands and that are also suspected of being worst case situations, in terms of local residents' exposure. The Committee considers it advisable for the study to focus on:

- the flower bulb cultivation sector: of all types of open field cultivation, this involves the highest levels of plant protection product use (in kg/ha/yr);
- orchards: these are a special case, as they use sideways or upwards spraying, and they require large amounts of product (in kg/ha/yr).

In addition, the following could also be investigated:

- the greenhouse cultivation sector: here too (at least for some types of plant cultivation) extensive use is made of products (including illegal ones). There is also evidence that emissions from greenhouses to the outdoor air are of the same order of magnitude as those from open field cultivation.[208]

6.2.3 *Which target groups?*

The Committee recommends that the exposure study focus on three groups of local residents: farmers and growers (who apply plant protection products themselves or who work with treated crops), their family members and, finally, people not involved in agriculture. Those local residents who do not work in the agricultural sector often believe that they suffer greater exposure than the farmers and growers who apply products themselves. The latter, after all, use personal protective equipment and enclosed tractor cabs. In spite of this, scientists and risk assessors expect that operators and workers suffer significantly higher

exposure. This is because the former prepare the spraying liquid and maintain the equipment, while the latter often do not wear protective clothing. Biomonitoring data seems to confirm this.[87] Nevertheless, research shows that highly exposed individuals in the general population sometimes reach occupational exposure levels[87] and that bystanders present during sprayings sometimes suffered higher exposure than had been expected on the basis of calculations.[209] The inclusion of people not involved in agriculture in the study, as well as farmers and growers, should help to clarify this issue. Comparisons between the members of farmers' and growers' families and people not involved in agriculture should help to determine the extent to which farmers and growers form a source of contamination for the members of their households.

The Committee feels that it would be useful to include suitable control populations in the study, as this makes it possible to find out how much of the exposure to plant protection products is due to living near treated areas and how much to diet or to private home and garden use. The control subjects might be individuals from areas characterised by other types of crops (where the products being investigated in the study are not used) or those who live in grassland areas. Another option is to use the residents of agricultural areas as their own control group, by carrying out another set of measurements outside the spraying season.

The Committee believes it is crucial to focus particularly on women of childbearing age (with a view to exposure of the unborn child) and on children below the age of four. The latter's distinctive behaviour (placing hands and other objects in their mouth, crawling) and their smaller stature mean that they often suffer higher exposure (per kilogram of body weight) than adults. Furthermore, numerous developmental processes are taking place in the unborn child and in young children. These processes are susceptible to disruption by toxic substances, which can have lasting effects on health. According to the Committee, if local residents are at some risk from the agricultural use of chemical plant protection products in the vicinity, then the risk is greatest in young children. Young children are excluded from the British biomonitoring study. A separate focus on other groups that may be at increased risk, such as the elderly, merits consideration.[210]

In the British study, participants were recruited by first approaching farmers and growers, then local residents living within a 100-metre radius of participating agricultural holdings.[9] According to the Committee, one problem with this approach is that the participating agricultural holdings may not be a representative random sample. The participating farmers and growers might be trailblazers with greater than average environmental awareness. Alternatively, they might simply be taking extra precautions in the knowledge that they are

being scrutinised by the researchers. As a result, the study might paint too rosy a picture of reality. The Committee feels that there is no entirely satisfactory way to resolve this problem. It may be possible to get an impression of the degree of bias involved by taking limited measurements in the vicinity of agricultural holdings that are not participating in the study.

The behaviour of participating local residents, too, may not be entirely representative. As they become more aware of the risks involved, and make greater use of the risk control options that the Committee offers them in Chapter 7, their exposure will drop. This problem may be partly overcome by restricting the study to areas whose residents are not excessively concerned, and by taking measurements over protracted periods of time. All things considered, the Committee recommends that anyone interpreting the results should make allowance for the fact that the outcomes may be somewhat rose-tinted.

6.2.4 *What type of measurements?*

As the Committee has already pointed out, it expects that a combination of research methods will offer the best guarantee of reliable and interpretable results. This involves measuring internal exposure by means of biomonitoring, measuring external exposure through the analysis of contact media, and gathering additional information on factors that can affect exposure. The latter include current usage data, the distance between homes and agricultural land, local residents' activity patterns, dietary patterns, private use of plant protection products, biocides and medicinal products (including veterinary medicinal products) and weather conditions.[Compare40]

It is recommended that the study should focus more intensively on exposure pathways (such as vegetable gardens and take-home) that, due to a lack of the requisite knowledge, have not yet been included in the method being developed by the European Food Safety Authority to estimate the exposure of local residents.[8]

When measuring food and environmental samples, it is useful to measure both the parent compounds and the conversion products. In this way it is possible to work out which proportion of the conversion products found in human tissues or excretory products (urine) was absorbed in this form (in the diet or from the environment), and which proportion was absorbed as the parent compound.[211-213]

6.2.5 *Timing of sampling*

Once taken up by the body, many modern plant protection products are rapidly broken down and excreted, so they do not persist in the human body for very long. Accordingly, if an accurate picture of local residents' exposure is to be obtained, then the timing of urine sampling is crucial. If too much time elapses between the moment of exposure and the point at which samples are taken, then no plant protection products (or their metabolites) will be found. This will result in an underestimate of the actual exposure. So when investigating the exposure suffered by local residents following the application of plant protection products on agricultural land in the immediate vicinity, it is vital to know when the farmers/growers in question will be carrying out spraying operations. This information can then be used to determine the time of sampling.

The Committee recommends that urine samples be taken on several separate days (before and after spraying operations) from some or all of the participating individuals. Experience has shown that a time series of samples from the same individual makes it easier to interpret monitoring data (see Chapter 5). This approach gives a reliable picture of local residents' peak exposure. If samples were also taken (perhaps less frequently) outside the spraying season, this would reveal the pattern of internal exposure throughout the year. It would also show how the importance of different exposure sources and pathways varies from one season to another.

The use of plant protection products can vary quite considerably over the years, in response to changing weather conditions and pest pressures. Accordingly, measurements should preferably be taken over several years, as in the British study. The sum of these measurements can be used to determine the chronic exposure suffered by local residents.

When the participants submit their urine samples, it is vital that they do so with all due care and attention, and in full compliance with the agreed procedures. One problem with protracted studies is that it is difficult for the participants to stay motivated, and to maintain high standards of due care. The British researchers have devised what the Committee considers to be an elegant solution, in the form of 'community researchers'.[9] These locally recruited personnel are first given a thorough training course, after which they recruit participants, instruct them, and collect samples. They maintain all of the contacts, and provide a channel of communication with the participants. These individuals are the local face of the research team. Over time, they develop a relationship with the participants. The Committee takes the view that it would be

sensible to appoint such community researchers in the Dutch study as well. They might, perhaps, be recruited from among existing medical staff, such as district nurses, social nurses (employed by municipal health services), or nurse practitioners (in general practices).

6.2.6 *Other aspects*

Ethical and legal aspects

Exactly which Dutch legislation is applicable depends on the exact design of the study in question. More specifically, the legislation in question involves the Medical Research Involving Human Subjects Act (WMO)[214] and the Population Screening Act (WBO).[215] This legislation imposes numerous obligations on researchers to protect anyone participating in the study. It is not possible to determine whether the study falls within the scope of this legislation until detailed study protocols have been drawn up. However, even where this is not the case, the Committee considers it advisable to seek advice by submitting the study protocol, in due course, to an accredited medical research ethics committee (MREC). This was, indeed, the course of action taken by the British study.[9] The participation of very young, mentally incompetent children is an additional reason for consulting a MREC. Particular care must be taken to ensure that the participating local residents and farmers/growers are given feedback about the results of the study (see details of a Flemish protocol for providing feedback about biomonitoring results[216], for example). The feedback procedure must be established before the start of the study. The Committee recommends that, before a decision is taken in this matter, representatives of the stakeholders in question be asked for their views about the various options.

Communication

In a previous advisory report, the Health Council announced that it considered risk communication (especially in the form of resident participation) to be an essential part of the approach to local environmental issues.[199] However, as the Council commented at the time, it makes little sense to get people involved if no use is subsequently made of their comments and opinions. Indeed, this can even be quite counterproductive. In line with this, the Committee takes the view that a dialogue is needed between the researchers and each of the stakeholders. This process should not be deferred until the results are in, but should also take place during the study's preparation stages and while it is under way. The Committee

recommends that a stakeholder focus group be set up for this purpose. This should ensure that the study is adequately tailored to the information needs of all stakeholders, while reassuring everyone that it is being conducted professionally and independently. The language used by the researchers must also be in keeping with the target groups' knowledge levels.

Cost

According to the researchers that were contacted, the cost of the British study was in excess of GBP 0.5 million. However, that study has a narrow objective, so it is limited in scope (3 research areas, 4-5 substances, no young children among the participants, only biomonitoring, limited time series of samples). The Committee expects that the study, as outlined above, will involve a budget of several million euros.

6.2.7 Long-term exposure monitoring

The Committee recommends that the proposed exposure study be supplemented by the more or less permanent monitoring of human exposure, much like the current monitoring of water quality and of residue levels in food products. Biomonitoring is well suited to this purpose. The agricultural sector is constantly evolving: types of crops, plant protection products, application techniques and agricultural practices are all continually changing. Monitoring can show whether the approval procedure and measures for everyday practice are adequate today and whether they remain so in the future. It can also provide information regarding any changes that may be required. For the time being, it also is the only way of determining and ensuring that our approval systems for individual products (which, also, usually only address exposure from a single source, and via a single exposure pathway) provide sufficient protection. The temporary biomonitoring study among local residents proposed by the Committee could provide valuable lessons for a more continuous monitoring structure of this kind, while perhaps at the same time constituting a first step in this direction. Some projects are already up and running at European level (COPHES and DEMOCOPHES, see http://www.eu-hbm.info/cophes). Their goal is to harmonise the approach to biomonitoring among the various countries involved. The Committee is in favour of joining these projects (or new ones) and of expanding their scope to encompass modern plant protection products.

6.3 Conclusions and recommendations

The Committee feels that it makes sense to investigate the situation among local residents, starting with an exposure study. Based on the results obtained, an assessment could then be made of the potential usefulness of a study into health effects, and consideration could be given to the practical details involved. The best way to conduct an exposure study is to combine a range of different research methods. Biomonitoring (in this case, the measurement of plant protection products and their metabolites in the tissues or excretory products of local residents) provides information about their total exposure from all sources and via all pathways. Measurements in contact media, such as air, soil, water, house dust, etc., in combination with additional data on exposure-determining factors (agricultural use of plant protection products, behaviour of local residents, dietary patterns, private use of plant protection products and biocides, distance from agricultural land, weather conditions) can provide some insight into the relative importance of sources and exposure pathways. Only a fully comprehensive study of this kind can clarify the extent to which the agricultural use of plant protection products in the immediate vicinity contributes to total human exposure. This information is also needed to refine the exposure models used in the approval procedure and to evaluate the need for, and effectiveness of, exposure reduction measures by national and local governments, farmers, growers, and local residents themselves.

The Committee recommends that the exposure study should focus on farmers and growers, their families, and those not involved in agriculture. There should be a special focus on women of childbearing age (with a view to the unborn child) and very young children. Modern plant protection products degrade very rapidly, and there is a substantial temporal variation in exposure. This means that intensive sampling and research over a period of several years is required. Knowledge of suitable biomarkers in human tissues and excretory products (including the associated biomonitoring equivalents) is indispensable in this regard and will have to be developed where necessary. The Committee expects that the above-mentioned research will involve a budget of several million euros.

Follow-up research into health effects can be useful if the exposure levels of one or more plant protection products are found to be close to, or above, health-based limit values. In such cases, it makes good sense to take additional exposure reduction measures (further to those already being advocated by the Committee in Chapter 7), rather than to wait for the results of long-term epidemiological studies into health effects.

The Committee takes the view that effective communication with all stakeholders before, during and after the study – concerning its purpose, design and outcome (or potential outcome) – is crucial. It should be clearly explained to participants, in advance, that it is the levels of plant protection products rather than their mere presence, as such, that determine whether there are risks to health. It is advisable to seek advice by submitting the study protocol, in due course, to an accredited medical research ethics committee.

Given the on-going changes in plant protection practice, the Committee recommends that consideration be given to the continuous monitoring of external and internal human exposure to plant protection products. This would generate valuable information on the effectiveness of current policy vis-à-vis these products. The study among local residents proposed by the Committee could provide useful lessons for a continuous monitoring structure of this kind, while perhaps at the same time constituting a first step in this direction.

Chapter 7

Proposed measures

In this chapter the Committee outlines some possible courses of action available to national and local governments or other stakeholders. These will allow them to respond to the concerns of local residents, which partly stem from the scientific uncertainty in this area.

7.1 How to proceed in situations involving uncertainty

In the Netherlands, as the previous chapters have shown, very little information is available concerning human exposure to plant protection products. Numerous residue analyses and measurements of drinking water have created a fairly good understanding of the substances that people ingest (actually or potentially) with their diet. However, very little is known about the exposure that people suffer in the course of their work, through the private use of products, or from the environment. There have been few recent measurements in contact media (with the exception of surface water), and there is almost no recent data on internal exposure from the analysis of urine, faeces, blood or expired air. It is therefore unclear whether current plant protection policy is sufficiently effective in terms of human exposure through work, private use, or from the environment. The study outlined in the previous chapter aims to fill this gap and to clarify the issue of human exposure, especially in agricultural areas. However, the process of political decision-making and the implementation of the study in question will both take a great deal of time. The results will not be available for several years.

Even then, the chances are that they will not enable every single question to be answered satisfactorily. So the uncertainty will continue, for a while at least.

Several years ago, the Health Council defined the precautionary principle as a strategy for dealing with uncertainties in a careful fashion.[217] At the time, the Dutch government embraced this viewpoint.[218] According to the Committee, an appropriate way to give shape to this strategy would be to implement measures that involve little or no expense, or whose additional benefits mean that they are always worthwhile. More expensive measures are also worthy of consideration. In the following Sections, the Committee outlines various measures that might be feasible in this connection. These can be categorised as changes to the approval procedure and measures in agricultural practice.

The existence of this list of measures does not mean that the Committee is convinced that the health of people in agricultural areas is being seriously impaired. It should, instead, be seen as a response to the prevailing scientific uncertainty, and to the resultant concerns expressed by some local residents. Such concerns have an adverse impact on these individuals' quality of life which, of itself, is a good reason for taking action.

7.2 Changes to the approval procedure

7.2.1 Filling the gaps that have been identified

The Committee considers it vital that further efforts be made, at international level, to fill in the gaps in the approval procedure described in Chapter 3, and that the Netherlands should take part in this. Not only is the Netherlands rich in expertise, but its participation also increases the chance that any methods developed in this context will be suitable for the assessment of risks under conditions that are specific to this country. This will not only benefit local residents, but also anyone who might come into contact with plant protection products, i.e. operators, workers, bystanders, passers-by and consumers.

The Committee also recommends that the Netherlands should launch a further debate, within the EU, about whether the approval dossier provides adequate guarantees concerning the details of a product's kinetics (the fate of a substance) in the human body. This information is essential to the development of a biomonitoring equivalent for the product in question. In addition, details of the methods used to analyse human blood and urine should be a standard feature of the approval dossier submitted by manufacturers. To date, however, this has not always been the case.

7.2.2 *The EFSA's method for assessing the risks to local residents*

The Committee would now like to consider one of the gaps mentioned – risk assessment for local residents – in greater depth. After all, the Council was specifically asked to comment on the new methods currently being developed, in an international context, for this very purpose.[8] The Committee believes that local residents constitute a clearly distinct group, one that should be considered separately in any risk assessment. Unlike operators and workers, local residents include young children, the elderly and the chronically ill. Local residents differ from bystanders and passers-by in terms of their pattern of exposure. In addition to brief peak exposures, the latter involves more chronic exposure to substances at lower levels and in various combinations. The Committee is, therefore, pleased to note that development work has started on a harmonised methodology for the assessment of risks to local residents.

The Committee has applied the European Food Safety Authority's (EFSA) method to various plant protection products used in lily cultivation to calculate how the exposure of local residents relates to the A(O)EL. Based on these calculations, it was not able to rule out the possibility that, in one case, young children might suffer exposures in excess of the health-based limit value. However, the Committee is at pains to point out that this calculation involves numerous worst case assumptions, and that the EFSA's method, as it currently stands, is nothing more than an initial, exploratory step. It is still undergoing rapid development. A second version (as yet unrefined and unpublished) was recently submitted to the EU member states' approval authorities for comment. Thus, for the time being, no great significance can be attached to the results of the Committee's calculations. However, this does illustrate the need for the method to be further developed. The Committee expects the findings of the BREAM and BROWSE projects (see Chapter 3) to be helpful in this regard. The matter of whether or not risks to local residents can be effectively covered by incorporating the EFSA's method into the approval procedure is something that will only become apparent in due course, by reference to monitoring data from the everyday situation.

The EFSA has itself identified a number of gaps in its own approach that still need to be filled. Some examples are exposure via people's contaminated vegetable gardens and the introduction of plant protection products into homes by operators and workers (on their clothing and footwear) or by pets. Exposure studies are needed to close this gap, as proposed in the previous chapter.

In addition, the EFSA's method is not yet tailored to assessing the risks to those living in the vicinity of greenhouses. At present, the Netherlands uses its own method for assessing these risks. The Committee considers it advisable that this method be documented in such a way that it can be readily incorporated into the EFSA's method. Failing that, it recommends that an alternative approach be adopted to achieve the harmonisation of this assessment. Given the substantial area of land devoted to greenhouse horticulture in this country, the Committee urges the Netherlands to take a leadership role in this endeavour.

It will probably be quite some time before the EFSA's harmonised approach is ready for implementation in the EU member states' approval procedures. In the meantime, the Committee recommends that the Netherlands use the less comprehensive, but fully operational, British[219] and German[220] methods. A sampling procedure can be used to establish whether there is a genuine need to submit every plant protection product that has already been approved to an additional assessment, to determine whether they pose any risk to local residents. Products can be selected in accordance with the criteria set out in Section 6.2.

The EFSA rightly argues that the risks posed to local residents by peak exposures are, in theory, covered by the assessment of these risks to bystanders and passers-by. Here too, the method used for the latter assessment has yet to be harmonised at European level. The method currently being used by the Netherlands focuses solely on non-casual occupational adult bystanders and passers-by (without protective clothing), which excludes children. In anticipation of a harmonised European approach, the Committee recommends expanding the national assessment procedure to include casual non-occupational bystanders and passers-by (which would include children). The German method mentioned above also includes a calculation for casual non-occupational bystanders, including children. The British method assesses casual non-occupational adult bystanders.

7.2.3 Public information campaigns about the approval procedure

The Board for the Authorisation of Plant Protection Products and Biocides is responsible for conducting an adequate assessment of the acceptability of plant protection products and biocides that manufacturers want to market in the Netherlands. However, the general public has little or no understanding of how the approval procedure works. This leads to misconceptions and a lack of confidence. The Committee, therefore, recommends that the Board should focus more on providing adequate information to the public about the approval procedure, in terms that are understandable to laymen. The illustrations

presented in this advisory report could usefully serve as starting material in this endeavour.

7.3 Measures in agricultural practice

However necessary it might be, making improvements to the approval procedure is fraught with difficulty. This is because it involves increasingly complex issues, as well as international coordination. Conversely, the Netherlands has much more control over the issue of cutting exposure, so it can get results more quickly. The following measures can help, directly or indirectly, to reduce the exposure suffered by local residents. They are grouped according to the stakeholder that is in a position to implement the measure in question. Several of these measures have already been taken by the above-mentioned stakeholders, in connection with other benefits. They will be part of plant protection policy for the coming years, as laid down in the Second Policy Document on Sustainable Plant Protection.[86]

7.3.1 By national or local government

- Integrated plant protection: in creating a sustainability-oriented plant protection policy, the government has made a strong commitment to the promotion of integrated plant protection (see Chapter 3).[86] It is striving to cut the use of chemical plant protection as much as possible by giving priority to other methods of preventing or combating diseases and pest infestations. It goes without saying that cutting the use of chemical plant protection products will immediately lead to reduced exposure, not only for farmers, growers and workers handling plants, but also for consumers, passers-by and local residents.
- Enhanced enforcement: given that farmers and growers do not give safety sufficient priority in their business operations and do not comply fully with all conditions of use, the Committee feels that enhanced supervision by the various inspectorates (Netherlands Food and Consumer Product Safety Authority, Inspectorate SZW, Human Environment and Transport Inspectorate) is required. This is consistent with the PBL Netherlands Environmental Assessment Agency's recent recommendation that a firm commitment be made to compliance and supervision within the framework of a recalibrated environmental policy.[221]
- Effective complaints structure: those living in the vicinity of agricultural land occasionally indicate that they do not know who to contact concerning their

complaints about the careless use of plant protection products, their health problems or their concerns. They sometimes feel that agencies do not give them the help that they need, or that they are being sent from pillar to post. This recently prompted a group of private individuals to set up an electronic hotline (www.gifklikker.nl). However, the Committee feels that it is the government's duty to register complaints, as was indeed pointed out during the hearing by local residents and environmental organisations. The municipal health services have the statutory duty of answering the public's questions about ways in which the living environment might affect their health. Any questions or reports about compliance should be addressed to the Netherlands Food and Consumer Product Safety Authority. The Committee recommends that both organisations optimise their public service procedures, and that they enhance and intensify their mutual cooperation in the area of plant protection products. There should be a particular focus on the feedback provided by these organisations to people reporting problems or asking questions. The registration of all reports, questions, and complaints (along with annual reports) can show how often such incidents occur, while revealing the depth of concern among those living in agricultural areas, and highlighting trends over time. This is of great value for the periodic evaluation of plant protection policy. This is also consistent with the EU Directive establishing a framework for Community action to achieve the sustainable use of pesticides. The Directive requires member states to set up systems for collecting information on incidents involving acute and chronic poisoning in groups that may be regularly exposed to plant protection products, including those living in the vicinity of areas where these products are applied.[78]

- No-spray zones and separation distance requirements are measures that can have a major financial impact. One problem is that it is difficult to provide a precise scientific description of the relationship between the distance to a treated area and the exposure suffered (thus also risk). This varies with the nature of the product, its formulation, the application method used, the layout of the landscape and the weather conditions. However, it can be stated that exposure decreases as distance increases. In theory, if the approval procedure is well organised and if all of the rules and regulations are complied with in practice, then the risks to local residents should be covered and separation distance criteria are not required. Thus, according to the Committee, no-spray zones and separation distance criteria should be seen more as measures that provide a safety margin (or an additional safety margin). This is because certain aspects of the approval procedure are not (or not yet) properly

regulated and because, in everyday situations, there is not always full compliance with the conditions of use. The present lack of details about local residents' exposure levels is mirrored by uncertainty about the need for exposure reduction. In the present climate of uncertainty, arguments can be made both for and against the establishment of no-spray zones. Ultimately, this is a political choice. Given that narrow no-spray zones are already in place along waterways, the Committee believes that the introduction of no-spray zones around schools, homes and the like represents an obvious next step. The designated width of such zones will be a reflection of what politicians consider to be an appropriate balance between health-based and economic values. In this connection, consideration should be given to imposing a measure of differentiation, depending on the nature of the building involved (detached homes, terraced housing, school, etc.). The question of whether this issue should be tackled at national or local level (via zoning) is also a matter for those in political circles. The current trend is to increasingly deal with these issues at local level, as this makes it possible to weigh up local interests.[222] This is one of the aspects addressed by the upcoming Environment and Planning Act. However, plant protection product policy was drawn up along national and international lines. Thus the separation distance requirement for watercourses applies throughout the country. In that sense, it is logical for no-spray zones between agricultural land and homes, schools, etc. to be established at national level.

7.3.2 *By the agricultural sectors*

- Safety awareness: it is important for farmers and growers to give greater priority to safety in their business operations. This primarily applies to their own safety and that of their employees. How can local residents be confident that their health is in good hands if the farmers and growers in question do not do enough to ensure their own safety? The unions and the agricultural sectors have recently joined forces to tackle this sticking point. They have set up a digital toolbox as a source of useful information and as a way of promoting safety awareness among farmers and growers (www.beschermbewust.nl). Moreover, farmers and growers must not only give greater consideration to the safety of casual non-occupational bystanders and local residents, they must also demonstrate their commitment in practice. One possible approach is to take account of the weather conditions. For instance, spraying operations could be postponed if there is a risk that the speed and direction of the wind might cause spray to drift onto

the homes of those living in the vicinity. The Committee recommends that training programmes leading to a certificate of professional competence (plant protection spraying licence) should give greater emphasis to safety aspects, including the safety of local residents.

- Good Neighbour Initiative: stakeholders in the UK have launched the Good Neighbour Initiative.[223,224] With the aid of educational materials, they are encouraging farmers and growers to communicate with local residents on matters such as the need to apply plant protection products, the nature of the products in question, and details of where and when they will be applied. Farmers and growers are also being urged to familiarise themselves with the concerns of local residents, and to work with them to find viable solutions that can ease or eliminate these concerns. During the hearings held by the Committee, representatives of various agricultural organisations expressed a willingness to help set up a similar initiative here in the Netherlands. They have now developed educational materials for farmers and growers, which shows them how to deal with local residents' concerns and interests in a carefully considered way (http://www.lto.nl/actueel/Nieuws/10834831/Campagne-gewasbescherming-en-omwonenden-van-start). The Committee believes that, when communicating with local residents about the use of plant protection products, farmers and growers could also make effective use of the above-mentioned digital toolbox that was originally created for their own safety. If the farmer or grower shares this information with local residents, it may help to reassure them that he is aware of the dangers and is taking appropriate measures, for his own safety and for theirs. Effective communication between both parties also provides greater scope for those local residents who wish to take additional measures of their own (see Section 7.3.4).
- Monitoring of exposure: the Committee recommends that employers and employees in the agricultural sector make more effective use of the periodic medical examination (PMO). In this context, they could also have blood and urine samples taken more frequently, to monitor their exposure to plant protection products. This could, perhaps, be linked to the continuous monitoring study recommended by the Committee in Section 6.2.
- Technical solutions: the agricultural sectors are expected to implement integrated plant protection in the everyday situation. If the use of chemical products is absolutely necessary, then technical provisions can help to reduce emissions. At the hearing, representatives of the agricultural sector indicated that they already have plans for making greater use of low-drift spray nozzles. The goal is to expand their use from water margins (which in some

cases is already mandatory) alone, to include other sensitive structures, such as homes and schools. This can help to reduce spray drift. Developments in the area of spraying systems can reduce this drift still further.[225] In addition, some types of spraying equipment can achieve a better distribution of the plant protection product in the crop. In other cases, any spraying liquid that misses the crop plants can be collected for reuse. The use of GPS systems can prevent any overlap between spraying strips. Sensor-controlled spraying can fine-tune the quantity of product delivered by each spray nozzle to the number of crop plants to be treated (or weeds to be killed). These developments can deliver savings in terms of the amount of product used (see http://www.riwa-maas.nl/nl/innovatieve+technieken). This has a beneficial effect on the emission of plant protection products to the air and to other environmental compartments following their application. In the future, 'precision pest control' could lead to the increasingly efficient use of chemical plant protection products.[226] Given the considerable costs that this might involve, the key question is whether this technology will be accessible to all farmers and growers or to all sectors.

- Windbreak plants: growing windbreak plants along field margins can often block a significant portion of the dispersing spray drift.[227,228] One approach, for example, involves planting trees around orchards. Evergreen species are particularly effective in this regard. However, this approach is less efficient at filtering out vapour.

7.3.3 By the manufacturers and distributors of plant protection products

- Product innovation: manufacturers are constantly working to develop plant protection products that are more effective and less harmful to the environment. Aside from the active ingredients, the adjuvants added to these products are also relevant. Added substances increase a product's viscosity, thereby increasing the droplet size during spraying. In this way, spray drift can be limited.[228] The formulation can also help to ensure that the product adheres better to the plant, that less of it drips off or washes off, that it is better distributed over the plant's surface, and that it is more efficiently absorbed. This increased effectiveness allows savings to be made in terms of dosages, thereby reducing emissions to the air and to other environmental compartments.
- Information campaigns and training: the distributors and manufacturers of plant protection products are already running numerous information campaigns, and giving extensive training to their customers. The Committee

recommends that, in this connection, still greater emphasis be placed on safety. This applies not only to the safety of farmers or growers themselves, but also to that of local residents.

7.3.4 *By local residents themselves*

It should not actually be necessary for local residents to have to take additional measures of their own. In the ideal situation, both the approval procedure and the way in which practical conditions of use are implemented should be designed to eliminate all but the most negligible risk to local residents. Unfortunately, current practice does not conform to this ideal, which is why the above recommendations have been addressed to various levels of government, to agricultural sectors, to commercial interests, and to manufacturers. While the situation is not ideal, the actual extent of any increased risk of health impairment to local residents is unclear. The studies proposed by the Committee could shed some light on this issue, but it would take several years to complete them. In an effort to offer local residents some degree of control over their personal circumstances in this uncertain situation, the Committee has suggested the following measures. However, the Committee does not know how often these measures should be implemented, or for how long, nor can it say how effective they are or how serious the consequences might be if they were to fail. Indeed, it is not even clear whether there is any need for such measures at all. In general, however, these measures will have a beneficial effect on exposure. If such measures only need to be taken once or twice a year, then the effort involved should not be excessive. However, if such steps have to be taken dozens of times in a single growing season then this would significantly impact the personal freedom of local residents. The only remaining way for them to alleviate their burden involves relying on the measures that other parties (particularly farmers, growers, and government bodies) are willing to take in the context of burden sharing. The measures that local residents themselves can take to reduce their exposure are as follows:

- Washing any fruit, vegetables and herbs grown in their own vegetable gardens prior to consumption, if these gardens border on fields where plant protection products are applied.[229] In fact, this is always a good idea, regardless of where fruit, vegetables, and herbs are actually grown.
- Keep the windows closed while an adjacent plot of land is being sprayed (and shortly thereafter).[229]
- Avoid sitting and playing in the garden while an adjacent plot of land is being sprayed (and shortly thereafter). Pets should temporarily be kept indoors.[229]

- Do not hang laundry out to dry while an adjacent plot of land is being sprayed.
- If you suspect that a road or area of land that you have walked across has recently been contaminated by spray drift or by a spillage of spraying liquid, take off your shoes before entering the house.[229]

In addition, the Committee considers it important for local residents to:

- approach the farmer or grower in question to discuss their concerns and wishes, and to seek solutions together. Constructive contacts with the farmer or grower in question also make it easier for local residents to take personal measures.
- use the complaints structures provided by local and national governments to report concerns or health problems that they associate with the use of plant protection products (municipal health service), or if they suspect that a plant protection product is not being used in accordance with the conditions of use (Netherlands Food and Consumer Product Safety Authority).

7.4 Conclusions and recommendations

It will be some time before the exposure study proposed by the Committee can provide greater clarity about the extent to which those living in the vicinity of agricultural and horticultural land (including farmers and growers, and their families) are exposed to chemical plant protection products. Meanwhile, the government can work to further improve the approval procedure in general, and to add a separate risk assessment for local residents in particular. This is necessary, according to the Committee, because local residents constitute a clearly distinct high-risk group. However, the method that the European Food Safety Authority is currently developing for this purpose is not yet ready for use. The Committee recommends that, in the meantime, the Netherlands should use the current German and British methods. A sample can show whether the plant protection products that have already been approved should be re-assessed for possible risks to local residents. The Committee recommends that the national method used in the Netherlands to assess the risks to those living in the vicinity of greenhouses be formally documented such that it can be incorporated into the European Food Safety Authority's method or, failing that, that an attempt be made to harmonise that method. The risks posed to local residents by peak exposures are, in theory, covered by the assessment of these risks to bystanders and passers-by. However, that assessment has not been harmonised at European level either. In addition, the Dutch assessment is focused only on non-casual

occupational bystanders and passers-by. The Committee recommends that this assessment focus on all bystanders and passers-by, which would include children. The above-mentioned German and British methods are suited to this end, as well.

Given the uncertainties about the risks to, and concerns of, some local residents, the best approach now in agricultural practice would be to take measures that either involve very little expense or that are worthwhile in terms of other benefits. These are measures that either directly or indirectly reduce local residents' exposure. It is precisely because of these wider benefits that they have already been partly implemented by stakeholders and have been incorporated into the planned plant protection policy for the coming years. The interests of local residents are an additional argument in favour of the prompt implementation of these measures. In addition, more expensive measures merit careful consideration.

The primary considerations for national or local government are integrated plant protection, greater compliance, establishing no-spray zones, improving the complaints structure for members of the public who have complaints or questions about the use of plant protection products in their immediate area, and improving the Board for the Authorisation of Plant Protection Products and Biocides' public information campaigns with regard to the approval procedure. The agricultural sectors could make greater efforts in terms of the safety of their own members and that of local residents. They could also do more exposure testing during periodic medical examinations, in addition to communicating more actively and effectively with local residents about the use of plant protection products. Finally, these sectors should continue development work on technical solutions to curtail spray drift and product consumption. Manufacturers and distributors can also target their information provision and product innovation on reducing the risks to local residents. In conclusion, the latter can also take steps to reduce their own exposure.

Chapter 8

Answers to the Ministers' questions

In the last Chapter, the Committee answers the Ministers' questions in the order in which they were asked.

- Is it possible for any exposure (resulting from the use of plant protection products) suffered by local residents to be so extreme that it could pose a risk to their health? In this connection, there should be a special focus on vulnerable or susceptible groups, situations involving high levels of exposure, and exposure to a mixture of substances.

It is unclear whether local residents here in the Netherlands are exposed to plant protection products to such an extent that this could pose a risk to their health. The Committee notes that, in the Netherlands, scarcely any research has been conducted into the exposure and health status of those living in the vicinity of agricultural and horticultural land, in relation to the use of chemical plant protection products. Accordingly, the Committee must, of necessity, base its judgment mainly on research carried out abroad (mostly in the United States).

The general population's exposure to plant protection products is usually significantly lower than that suffered by those who, in the course of their professional activities, have to deal with these products. Those living in the vicinity of land used for agricultural and horticultural purposes are exposed to plant protection products from their environment. There is evidence that the members of farmers' and growers' households tend to suffer greater exposure

than those in the households of people not involved in agriculture, living in the same area. If the measured or estimated exposure is compared to health-based limit values, the results suggest that in some cases those concerned (especially small children) can be at increased risk of health impairment. However, comparisons of this kind are fraught with great uncertainty.

Local residents can also be exposed to several different plant protection products, either simultaneously or in rapid succession. On theoretical grounds, it is reasonable to assume that exposure to several different products, all with the same mechanism of action, will tend to increase the level of risk involved. However, due to lack of monitoring data on local residents' exposure, it is not known whether this contributes to the risk run by the latter in practice.

In agricultural areas, local residents occasionally complain of nausea or of irritation affecting the skin, eyes or upper respiratory tract. A number of products are known to induce complaints like this at high levels of exposure. Only very rarely has the possibility of a link to exposure been investigated in the Netherlands, however.

The epidemiological literature (which is almost entirely based on research carried out abroad) contains some evidence that certain chronic disorders in local residents, such as effects on the unborn child, childhood leukaemia and Parkinson's disease, are associated with environmental exposure to chemical plant protection products. However, it is not possible to draw any firm conclusions on this matter. Many studies suffer from significant limitations, moreover only a small number of studies focus specifically on local residents. Furthermore, studies carried out abroad have relatively little bearing on potential exposure levels and health effects in the Netherlands. This is related to major differences in climate, landscaping and agricultural practice. If local residents in the Netherlands really are at increased risk of health impairment, compared to the general population, the Committee nevertheless suspects that they are at lower risk than those who suffer occupational exposure (which usually involves significantly higher levels of exposure). The risk is highest in special situations where a high level of exposure and a high degree of sensitivity are combined. The unborn child and young children are likely to be most at risk.

- Is it reasonable to expect that the use of a new European guideline in approval assessments could reduce the risks to local residents, and if so to what extent? Does this mean that there is no longer any cause for concern? Or are there still some aspects that require attention? If that is indeed the case, can these issues be adequately addressed by conditions of use, or will there still be specific points of concern? The lessons learned in Germany,

where a precursor of the European assessment method is being used, can be a valuable source of information here.

The Committee anticipates that the introduction of a separate assessment of risks to local residents into the approval procedure will help to keep any risks to this group within accepted limits. However, the method to be used for this purpose is still under development at the European Food Safety Authority, and it will be some considerable time before it can be incorporated into national approval procedures. In due course, comparisons with monitoring data on local residents' exposure should demonstrate the extent to which this method can offer effective protection. The European Food Safety Authority's method takes several obvious exposure pathways into consideration. However, it is unclear whether all major pathways have been included. An exposure study among local residents, as advocated by the Committee in its advisory report, could shed some light on this issue.

Until such time as the European Food Safety Authority's method becomes operational, it is recommended that the German and UK national methods be used to assess the risks to local residents of repeated and prolonged exposure. The current method for assessing the risks to bystanders and passers-by can also be used to curtail the risks to local residents of short-term peak exposures. To this end, the method must be applied to all bystanders and passers-by, and not just those who are in the vicinity for occupational reasons while spraying is in progress, as is currently the case in the Netherlands. The above-mentioned German and British methods can also be used for this purpose. In this way, the risks to small children of peak exposures are also taken into consideration. This is important in view of their exceptional sensitivity. The Committee recommends that a sampling procedure be used to establish whether there is a genuine need to submit every plant protection product that has already been approved to an additional assessment, to determine whether they pose any risk to local residents and to casual non-occupational bystanders and passers-by.

- I would request a special focus on risks that are specific to the Netherlands (and which will not, therefore, be addressed in the European guideline) such as the risks to those living in the vicinity of greenhouses. There are also exposure pathways that will not be included in the proposed assessment, such as the risks of consuming food from vegetable gardens adjacent to agricultural land that has been sprayed. Is there any reason to extend the approval assessment to cater for this, or are there relevant options in other

areas? If you have identified any gaps in our knowledge please send me the details, together with your suggestions on how they should be filled.

The largest knowledge gap is the lack of clarity concerning the quantitative contribution of the environment to local residents' exposure, relative to the exposure that they suffer from other sources, such as their diet. It is also unclear which of the environmental exposure pathways is dominant.

The European Food Safety Authority's method does not yet include exposure from vegetable gardens that have been contaminated by spray, or exposure via the 'take-home' pathway (contaminated clothing, footwear, pets' fur). An exposure study, as advocated by the Committee, could be tailored to shed light on the importance of these and other pathways.

The Netherlands is already using a national methodology to assess the risks to those living in the vicinity of greenhouses. The Committee recommends that this method be documented in such a way that it can be readily incorporated into the EFSA's method. Failing that, it recommends that attempts be made to achieve the harmonisation of these methods at European level. Given the substantial area of land devoted to greenhouse horticulture in this country, it would be quite natural for the Netherlands to take a leadership role in this endeavour.

While it is very important that the approval procedure for plant protection products be improved, this is a complex process. The issues involved are difficult ones, they have not yet been built into the procedure, and European harmonisation takes time. The Netherlands has much more control over the issue of reducing the use of these products and cutting exposure, so it can get results more quickly. The Committee cites a number of measures in this area, which various stakeholders are already taking, or have recently taken, in connection with other benefits. These measures have been incorporated into the government's plant protection policy for the coming years. Greater efforts in this area can also help to reduce the exposure suffered by local residents.

- I would like to hear your assessment of the usefulness and possible design of a study among the population.

Various gaps have been identified in the approval procedure; there is consistent evidence for the occurrence of health effects in farmers and growers, and some evidence (mainly from studies carried out abroad) for effects in local residents, as well as a lack of data from the Netherlands. For all of these reasons, the Committee feels justified in recommending that a study be carried out among local residents in the Netherlands. The obvious starting point would be an

exposure study. A more detailed knowledge of exposure is indispensable if any health effects in local residents are to be related to the use of plant protection products in the vicinity. The Committee recommends that the exposure study should focus in particular on high-risk groups, especially young children. The study should preferably involve a combination of research methods. These would involve biomonitoring (e.g. urine analysis), measurements in contact media (e.g. air and house dust) and questionnaires on exposure-determining factors (e.g. the exact products used, the dosages and application techniques involved, the weather conditions, the distance between homes and treated land, as well as the local residents' habits and activities). Follow-up research into health effects can be useful if the exposure levels of one or more plant protection products are found to be close to, or above, health-based limit values.

An exposure study would not only provide insight into the exposure suffered by, and possible health risks to, local residents in the Netherlands. It would also produce information on the relative and absolute importance of various exposure sources and pathways. This data is required to evaluate and improve the methods used in the approval procedure (such as the one designed by the EFSA) to estimate exposure. It is also required to make a judgment concerning the need for, and effectiveness of, measures to reduce local residents' exposure.

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Annexes

Annex **A**

The request for advice

On 18 April 2011, the President of the Health Council received a request from the Minister for the Environment for advice concerning the risks posed to local residents by the use of plant protection products. The Minister wrote (letter DP/2011043142):

In response to a request from my ministerial predecessor, the topic of the risks posed to local residents by the application of plant protection products was included in your 2011 work programme. My purpose in writing this letter is to further specify the question that you were asked on this topic. I will include recent developments on this topic. In doing so, I am also acting on behalf of my counterpart at the Ministry of Economic Affairs, Agriculture and Innovation.

The risks posed to local residents and bystanders by the use of plant protection products are not addressed in the approval assessment. The assumption was that the risks to local residents and bystanders were adequately covered by the assessment of the risks posed to operators. That assumption is increasingly being questioned at both the national and international level. Accordingly, the decision was taken at European level to address the risks in question. This has been incorporated into the new Regulation for the approval of plant protection products. Work is currently in progress on a technical guideline on how that assessment should be carried out.

The advisory report centres around the question of whether it is possible for any exposure (resulting from the use of plant protection products) suffered by local residents to be so extreme that it could pose a risk to their health. In this connection, there should be a special focus on vulnerable or

susceptible groups, situations involving high levels of exposure, and exposure to a mixture of substances. A number of local residents' groups are now concerned about this issue. In view of the public concern involved, local residents should ideally be involved in the process of drawing up your advisory report.

As soon as a European guideline for the approval assessment has been established, it will also be introduced in the Netherlands. Your advisory report can take this development into account. Is it reasonable to expect that the use of this guideline in approval assessments could reduce the risks to local residents, and if so to what extent? Does this mean that there is no longer any cause for concern? Or are there still some aspects that require attention? If that is indeed the case, can these issues be adequately addressed by conditions of use, or will there still be specific points of concern? The lessons learned in Germany, where a precursor of the European assessment method is being used, can be a valuable source of information here.

I would request a special focus on risks that are specific to the Netherlands (and which will not, therefore, be addressed in the European guideline) such as the risks to those living in the vicinity of greenhouses. There are also exposure pathways that will not be included in the proposed assessment, such as the risks of consuming food from vegetable gardens adjacent to agricultural land that has been sprayed. Is there any reason to extend the approval assessment to cater for this, or are there relevant options in other areas? If you have identified any gaps in our knowledge please send me the details, together with your suggestions on how they should be filled.

Finally, I would like to draw your attention to an even more specific question regarding this issue. This topic was discussed in a recent TV programme and in a subsequent political debate. It was suggested that population screening be used to identify the potential risks to local residents. I would like to hear your assessment of the usefulness and possible design of a study of this kind. Given the social and political focus on this suggestion, I would appreciate it if you could answer this question before tackling the full advisory report. It could take the form of an advisory letter. I would appreciate it if you could manage to complete this advisory letter before this summer.

Please send me an estimate of the time required to draw up the advisory report. Please feel free to request the involvement of my ministry and/or the National Institute for Public Health and the Environment (RIVM), in the form of an observer or adviser.

Yours sincerely,
The Minister for the Environment

(signed)
Joop Atsma

Annex **B**

The Committee

- Dr. F. Woudenberg, *chairman*
  Psychologist, GGD Amsterdam
- Prof. M. van den Berg
  Professor of Toxicology, Institute for Risk Assessment Sciences, Utrecht University
- Dr. P.J. Boogaard
  Toxicologist, Shell International BV, The Hague
- Prof. D.J.J. Heederik
  Professor of Health Risk Analysis, Institute for Risk Assessment Sciences, Utrecht University
- Dr. R.M. Meertens
  Psychologist, Maastricht University
- Prof. P.J.J. Sauer
  Emeritus Professor of Paediatrics, University Medical Center Groningen
- Dr. P.T.J. Scheepers
  Toxicologist, Radboud University Medical Center, Nijmegen
- Dr. F. van den Berg, *advisor*
  Environmental Chemist, Centre for Water and Climate, Alterra, Wageningen University & Research Centre
- M. Busschers, *advisor*
  Toxicologist, Board for the Authorisation of Plant Protection Products and Biocides, Wageningen

- M. Drijver, MD, *advisor*
  Health Council of the Netherlands, The Hague
- Dr. C.M.J. Jacobs, *advisor*
  Meteorologist, Team Climate Change and Adaptive Land and Water Management, Alterra, Wageningen University & Research Centre
- Dr. B.C. Ossendorp, *advisor*
  Risk Assessor, National Institute for Public Health and the Environment, Bilthoven
- Dr. M.N.E. Nelemans, *observer*
  Ministry of Infrastructure and the Environment, The Hague
- Dr. H.F.G. van Dijk, *scientific secretary*
  Health Coucil of the Netherlands, The Hague

The Health Council and interests

Members of Health Council Committees are appointed in a personal capacity because of their special expertise in the matters to be addressed. Nonetheless, it is precisely because of this expertise that they may also have interests. This in itself does not necessarily present an obstacle for membership of a Health Council Committee. Transparency regarding possible conflicts of interest is nonetheless important, both for the chairperson and members of a Committee and for the President of the Health Council. On being invited to join a Committee, members are asked to submit a form detailing the functions they hold and any other material and immaterial interests which could be relevant for the Committee's work. It is the responsibility of the President of the Health Council to assess whether the interests indicated constitute grounds for non-appointment. An advisorship will then sometimes make it possible to exploit the expertise of the specialist involved. During the inaugural meeting the declarations issued are discussed, so that all members of the Committee are aware of each other's possible interests.

Annex **C**

The advisory letter

Annexes A and B of this advisory letter are not included here as they are virtually identical to Annexes A and B of the present advisory report. Full details of the advisory letter are available at www.gr.nl.

Gezondheidsraad
Health Council of the Netherlands

To the State Secretary of Infrastructure and the Environment

Subject	: Advisory letter *Health risks caused by plant protection products in agriculture: the use of research among residents*
Your reference	: DP/2011043142
Our reference	: I-821/11/HvD/bp/887-C1 Publication no. 2011/18E
Enclosure(s)	: 1
Date	: September 2, 2011

Dear State Secretary,

On 18 April, also on behalf of your colleague of Economic Affairs, Agriculture and Innovation, you asked the Health Council of the Netherlands to advise you on the potential health risks for residents living near agricultural fields arising from the use of plant protection products. You ask a number of questions in your letter (see Annex A). First of all, you wish to know whether residents are exposed to a degree that endangers their health. You ask that particular attention be given to vulnerable groups, high-exposure situations, exposure to combinations of chemicals, populations living near glasshouses and exposure via contaminated vegetable gardens. Additionally, you wish to know to what degree a planned European adjustment to the authorisation procedure for plant protection products offers a solution. Finally, you ask the Council's opinion on the usefulness and design of population screening in order to determine health risks for residents.

In order to answer your questions, I will shortly be appointing a multidisciplinary committee. In accordance with your request, I will briefly address your final question in this letter. My answer is based on relevant previous advisory reports published by the Health Council of the Netherlands and consultation of members of and advisors to the Committee to be appointed (see Annex B) and the Standing Committee on Health and the Environment.

Usefulness and design of research among residents

Plant protection products may leave the treated field as a result of spray drift during application, or afterwards via volatilisation from the plants or ground.[1,2] They may also adhere to ground or dust particles spread by wind or carried on shoes or clothing.[3] Residents are particularly worried about the potential health consequences for themselves and their children in relation to crops that require intensive use of such chemicals, such as flower bulb production.[4] You ask whether population screening could shine a light on the health risks for residents. The term ‘population screening’ can

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mean a number of things. Sometimes this refers to screening individuals for a specific disease, such as breast cancer. Your question relates to research aiming to demonstrate or rule out health risks to residents due to the local use of plant protection products. For the sake of clarity, I prefer to use the term ‘research among residents’.

Research among residents living near agricultural fields can be split into two stages: exposure research and health research. The consulted Committee and Standing Committee members are unanimous in their opinion that exposure research is a necessary first step. In order to relate any health effects among residents to the use of plant protection products, greater knowledge of exposure is essential. Current insights into exposure levels for residents are largely based on models that may not include all relevant exposure situations. Measurement data on exposure of residents to plant protection products are scarce. In the Netherlands, only a few orienting studies have been conducted into plant protection product levels in air[5], ground[6], house dust[3,6], vegetables from kitchen gardens[6,7] and drinking-water from private wells[6]. This is external exposure. Internal exposure (levels in body materials such as blood or urine) of residents in our country has, to the best of my knowledge, hardly been investigated. Available data from other countries cannot easily be translated to the situations in the Netherlands. I therefore feel exposure studies among residents are definitely useful. It is worth recommending research focus on areas where, based on intensive use and application methods for plant protection products, relatively high levels of exposure may be expected.

Measurement data may clarify which chemicals residents are exposed to, what the average level of exposure is in the longer term, and what the peak exposure levels are. Data may also provide insights into what the distance of a house to a treated field means for the inhabitants' exposure levels, how exposure varies over time, and how model-based exposure estimates relate to measured exposure levels. A comparison with the exposure of people who do not live in agricultural areas can clarify to what degree residents face higher levels of exposure than the rest of the population, which may also be exposed to plant protection products, for example via consumption of sprayed fruits and vegetables. Checking measured exposure against reference levels deemed safe, such as those for exposure of individuals who apply the chemicals (so-called AOEL[a]) and consumers (ADI[b] and ARfD[c]) will indicate the level of risk. Based on the outcomes

[a] Acceptable Operator Exposure Level
[b] Acceptable Daily Intake
[c] Acute Reference Dose

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of exposure research, the usefulness and potential design of further health research may be determined.

In order to yield usable results, exposure research must meet certain conditions.[8] This relates to, among other things, the selection of suitable study populations, comparable control groups, chemicals to be measured, samples to be tested (*e.g.* air, house dust, urine) and timing, frequency and duration of measurement. Optimal design depends on the questions one wishes to answer. The Committee will therefore examine the issue of what type of exposure research can provide what kind of information.

Involving stakeholders

In your request for advice, you expressly requested that I involve residents in some way in drafting the advisory report. The Health Council of the Netherlands has previously emphasised the importance of citizen participation in dealing with environmental issues, particularly if they give rise to local worries[9] and are characterised by substantial uncertainty[10]. Both issues appear to apply here. In order to develop exposure research that will be able to answer the questions of worried residents, it would be wise to not only involve them in designing exposure research, but already involve them now in drafting the advisory report on the possibilities and limitations of such research. The Committee will deliberate carefully on how to give this involvement form. Additionally, I shall ask the Committee to consult stakeholders other than residents as well, such as the agricultural sector and the agrochemical industry.

Naturally, the Committee will also address the other questions you have asked. My goal is to have the Committee's advisory report ready for you during the course of 2012.

A copy of this advisory letter was sent to your colleague of Economic Affairs, Agriculture and Innovation.

Yours sinerely,
(signed)
Professor H. Obertop
Vice President

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Annex **D**

Participants at the first hearing

Date: Monday, 30 January 2012
Location: Jaarbeurs conference centre, Beatrix building, Jaarbeursplein, Utrecht

- Dr. J. van Aartrijk, Royal General Bulb Growers' Association (KAVB), Hillegom
- Mr. R. van Arendonk, Noord-Holland Environmental Federation, Zaandam
- Ms. A.G.A van Beek, Southern Agriculture and Horticulture Organisation (ZLTO), Den Bosch
- Prof. M. van de Bor, Oudemirdum Local Residents' Group
- Mr. E. Briët, Noord-Holland Environmental Federation, Zaandam
- Mr. J. van Bruchem, Dutch Fruit Growers Organization (NFO), Zoetermeer
- Mr. W. van Dalen, Bollenboos Foundation, Diever
- Mr. J. Dielissen, Bloemberg Local Residents' Group, Veeningen
- Mr. J. Eedens, Netherlands Food and Consumer Product Safety Authority, Utrecht
- Ms. R.V. Fournell, Bollenboos Foundation, Diever
- Mr. H. Hummelen, Dutch Federation of Agriculture and Horticulture (LTO) Groeiservice, Bleiswijk
- Mr. C. Koning, Houd Zijpe Leefbaar (the 'Keep Zijpe Liveable' association), Petten
- Prof. J. Lankelma, Oudemirdum Local Residents' Group
- Ms. M. Mann, Ministry of Infrastructure and the Environment, The Hague

- Ms. B. van Noorloos, on behalf of the Dutch Crop Protection Association (Nefyto), employed at Bayer Cropscience
- Mr. J.J.G.W. Ottenheim, The Dutch Crop Protection Association (Nefyto), The Hague
- Mr. C.M. de Ruijter, Agrodis (the trade association for distributors of plant protection products in the Netherlands), The Hague
- Mr. A. Schöppink, Bloemberg Local Residents' Group, Veeningen
- Mr. M.J.H.R. Steinbusch, CUMELA Nederland, Nijkerk
- Mr. B. Verhave, Bollenboos Foundation, Diever
- Mr. M. Visschers, Gelderland Nature and Environment Federation, Arnhem
- Dr. J.H. van Wenum, Dutch Federation of Agriculture and Horticulture (LTO Nederland), Zwolle

Present on behalf of the Health Council:

- Prof. H. Obertop, Vice President of the Health Council
- Dr. F. Van den Berg
- Prof. M. van den Berg
- Dr. P.J. Boogaard
- Dr. H.F.G. van Dijk
- Ms. M. Drijver
- Prof. D.J.J. Heederik
- Dr. C.M.J. Jacobs
- Dr. R.M. Meertens
- Dr. M.N.E. Nelemans
- Dr. B.C. Ossendorp
- Prof. P.J.J. Sauer
- Dr. P.T.J. Scheepers
- Dr. F. Woudenberg

Details of the lectures and presentations given by all the speakers can be found at the Health Council's website: www.gr.nl.

Annex **E**

Comments on public draft report

This annex gives details of those who commented on the public draft report and those who explained their comments at a second hearing held by the Committee. It also describes how the Committee dealt with these comments.

The Committee has received written comments on the text of the public draft report from the following individuals, organisations and bodies:

- The Agrodis trade association, The Hague
- Bloemberg Local Residents' Group, Veeningen
- Bollenboos Foundation, Diever
- Mr. B. Carpay, Huissen
- Mr. L.J. Dorst, Rutten
- Gelderland Nature and Environment Federation, Arnhem
- Schagen Local Authority
- Dutch Association of Municipal or Regional Public Health Services (GGD Nederland), Utrecht
- Mr. C.M.J.A. Goossens, 't Goy
- Houd Zijpe Leefbaar (the 'Keep Zijpe Liveable' association), Petten
- Dutch Federation of Agriculture and Horticulture (LTO Nederland), Zwolle
- Mr. K. Meijaard, 't Harde
- Noord-Holland Environmental Federation, Zaandam
- Overijssel Nature and Environment, Zwolle

- Dutch Crop Protection Association (Nefyto), The Hague
- Oudemirdum Local Residents' Group
- PAN Europe, Lekkerkerk
- Mr. J. Peeters, Fruitconsult, Zetten
- Prof. A.M.J. Ragas, Radboud University Nijmegen
- Mr. and Mrs (names confidential), Province of Noord-Brabant
- Dr. H.A. Tennekes, Zutphen
- Mr. J.J.A.H. Voet, Ministry of Economic Affairs, The Hague.

Details of all the comments submitted can be found at the Health Council's website: www.gr.nl.

Those participants at the first hearing who had submitted comments on the public draft report were given the opportunity to explain their comments verbally at a second hearing.

Date: Monday 7 October 2013
Location: Jaarbeurs conference centre, Beatrix building, Jaarbeursplein, Utrecht

Participants at the second hearing:

- Dr. J. van Aartrijk, Royal General Bulb Growers' Association (KAVB), Hillegom
- Mr. R. van Arendonk, Noord-Holland Environmental Federation, Zaandam
- Dr. R. Bogers, National Institute for Public Health and the Environment (RIVM), Bilthoven
- Mr. H. Bus, Dutch Fruit Growers Organization (NFO), Zoetermeer
- Mr. J. Dielissen, Bloemberg Local Residents' Group, Veeningen
- Ms. R.V. Fournell, Bollenboos Foundation, Diever
- Prof. J. Lankelma, Oudemirdum Local Residents' Group
- Ms. B. van Noorloos, on behalf of the Dutch Crop Protection Association (Nefyto), employed at Bayer Cropscience
- Mr. J.J.G.W. Ottenheim, The Dutch Crop Protection Association (Nefyto), The Hague
- Ms. J. Mat, NRC Handelsblad (newspaper)
- Mr. A. Schöppink, Bloemberg Local Residents' Group, Veeningen
- Mr. M.J.H.R. Steinbusch, CUMELA Nederland, Nijkerk
- Mr. B. Verhave, Bollenboos Foundation, Diever
- Mr. M. Visschers, Gelderland Nature and Environment Federation, Arnhem

- Dr. J.H. van Wenum, Dutch Federation of Agriculture and Horticulture (LTO Nederland), Zwolle

Present at the second hearing on behalf of the Health Council:

- Prof. H. Obertop, Vice President of the Health Council
- Dr. F. Van den Berg
- Prof. M. van den Berg
- Dr. P.J. Boogaard
- Ms. M. Busschers
- Dr. H.F.G. van Dijk
- Ms. M. Drijver
- Dr. C.M.J. Jacobs
- Dr. R.M. Meertens
- Dr. M.N.E. Nelemans
- Dr. B.C. Ossendorp
- Dr. P.T.J. Scheepers
- Dr. F. Woudenberg

In response to the comments it received, the Committee sent the following letter.

Gezondheidsraad
Health Council of the Netherlands

To those who contributed comments regarding the public draft report on plant protection and local residents

Subject	: Letter containing the Committee's reply
Our reference	: U-8044/HvD/pm/887-L1
Enclosure(s)	:
Date	: January 29, 2014

Dear Sir or Madam,

On 30 July 2013, the Health Council published a draft advisory report on plant protection and local residents on its website, and invited interested parties to comment on the text. In this way, the Committee that drew up the advisory report was able to carry out an interim check to see whether it had phrased its advisory report in intelligible terms, whether stakeholders' information needs had been met, and whether the available practical knowledge had been sufficiently utilised. Along with over twenty other individuals, groups and organisations, you have taken the time to post a response. The responses received varied in length from half a side of A4 to over twenty pages. The Committee has gratefully made use of the submitted comments. These have contributed to the quality of the final advisory report and to its usefulness for the State Secretaries who requested it.

The responses were mostly positive, but there were also criticisms of many kinds, ranging from misspellings, to suggestive language, inaccuracies and omissions. The Committee has critically assessed each of the submitted comments on their respective scientific merits and in terms of the extent to which they are in keeping with its assignment. Accordingly, it processed these comments as it saw fit.

Given the number and scope of the responses, the Committee is unable to send personal written replies to each and every contributor. Nor is it feasible to address each of the many modifications to the text, many of which were quite minor, while a few involved more substantial changes. I will confine myself here to the most important substantive impacts that your collective contributions have had on the final advisory report.

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The Committee has seen no reason to change the main thrust of the advisory report. However, where several different contributors expressed the same wish, it has addressed some matters in more detail. This concerns the following three points:

Further research into health effects: the Committee believes that it is worthwhile to carry out further research into these effects, if the exposure study it has advocated shows that exposure levels approach or exceed health-based limit values.

No-spray zones: as no-spray zones are already in effect along watercourses, the Committee feels that it is an obvious next step to introduce them around homes, schools and the like, but this is ultimately a political decision. Zones of this kind can provide a safety margin (or an additional safety margin). In scientific terms, there is no certainty about whether or not no-spray zones are really needed nor about how wide they should be. Exposure will, however, decrease as the distance increases. The designated width of such zones will be a reflection of what the responsible politicians consider to be an appropriate balance between health-based and economic values.

Personal measures taken by local residents themselves: here too, nothing is known about the need for such measures, nor indeed about their effectiveness. However, such measures do tend to reduce exposure while at the same time offering local residents some scope for action in what, for them, is an uncertain situation. The Committee has done away with the term 'no-regret measures', as these measures can substantially curtail local residents' freedom if spraying operations are carried out several times a week throughout the growing season.

Should you require further details about how the Committee has dealt with your own personal input, please feel free to call me or send me an e-mail. Thanks again for your input.

Yours faithfully,
on behalf of the Committee

(signed)
Dr. H.F.G. van Dijk
Scientific secretary

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Annex **F**

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Annex **G**

Use of plant protection products and emissions to the air

The use of plant protection products in various agricultural sectors (in kg of active ingredient per year) (excluding wet soil fumigation).[3]

	1997-1999	2004-2005	2008-2010
open field cultivation			
arable farming	5,724,000	4,855,000	4,660,000
flower bulb cultivation sector	1,609,000	1,431,000	1,520,000
arboriculture sector	227,000	240,000	270,000
fruit-growing sector	875,000	813,000	672,000
open field green crop cultivation	360,000	270,000	202,000
livestock industry	1,060,000	970,000	912,000
covered cultivation			
greenhouse floriculture	234,000	213,000	186,000
greenhouse green crop cultivation	51,000	54,000	50,000
edible mushrooms	7,000	5,000	1,000
total	10,147,000	8,851,000	8,473,000

Area per agricultural sector (in hectares); by comparison, the total land area of the Netherlands is 3,388,300 hectares.[3]

	1998	2004	2008
open field cultivation			
arable farming	517,000	511,000	482,000
flower bulb cultivation sector	18,000	20,000	21,000
arboriculture sector	12,000	14,000	16,000
fruit-growing sector	21,000	17,000	17,000
open field green crop cultivation	34,000	32,000	34,000
livestock industry	1,271,000	1,208,000	1,260,000
covered cultivation			
greenhouse floriculture	4,300	4,400	3,800
greenhouse green crop cultivation	3,000	3,300	3,700
edible mushrooms	100	80	80
total	1,881,000	1,810,000	1,838,000

The use of plant protection products in various agricultural sectors (in kg of active ingredient per hectare, per year).[3]

	1997-1999	2004-2005	2008-2010
open field cultivation			
arable farming	11.1	9.5	9.7
flower bulb cultivation sector	88.3	72.1	73.4
arboriculture sector	18.3	17.1	17.0
fruit-growing sector	42.5	48.7	40.1
open field green crop cultivation	10.5	8.4	5.9
livestock industry	0.8	0.8	0.7
covered cultivation			
greenhouse floriculture	54.0	48.2	49.3
greenhouse green crop cultivation	17.0	16.4	13.7
edible mushrooms	75.5	56.9	12.6
average	5.4	4.9	4.6

Calculated emissions of plant protection products to the air, surface water, and ground-water (in kg of active ingredient, per year).[3]

	1997-1999	2004-2005	2008-2010
air	1,026,000	757,000	710,000
surface water	24,300	16,300	12,900
ground-water	1,980	1,050	1,050

Calculated emissions of plant protection products to the air in various agricultural sectors (in kg of active ingredient per year).[3]

	1997-1999	2004-2005	2008-2010
open field cultivation			
arable farming	644,000	456,000	444,000
flower bulb cultivation sector	155,000	97,000	100,000
arboriculture sector	16,000	13,000	11,000
fruit-growing sector	84,000	94,000	65,000
open field green crop cultivation	42,000	25,000	18,000
livestock industry	55,000	51,000	56,000
covered cultivation			
greenhouse floriculture	17,000	15,000	13,000
greenhouse green crop cultivation	13,000	6,000	3,000
edible mushrooms	-	-	-
total	1,026,000	757,000	710,000

Annex **H**

Assessing the risks to humans as part of the approval procedure

The methods used in the approval procedure to assess the efficacy and safety of plant protection products have now been largely harmonised within the European Union. To some extent, that harmonisation has been expanded throughout the world. The methods for assessing efficacy and ecological risks are given no further consideration in this Section, as they are less relevant to the 'local residents issue'. The focus here is the assessment of risks to human health.

Within the European Union, methods for assessing the risks posed by plant protection products are developed by the European Food Safety Agency (EFSA), which is based in Parma. Within the EFSA, this task is the responsibility of the Panel on Plant Protection Products and their Residues (PPR). The active ingredients on the positive list – and, thus, the approved plant protection products as well – are periodically reassessed (at least once every ten years). This is partly because the test protocols used in the approval procedure are regularly updated in line with the latest findings. Another reason is that everyday practice can bring to light previously unsuspected harmful effects caused by the product. Interim intervention is, of course, always possible, even mandatory, in the event of unexpected adverse developments.

It is important to note that approval only implies that the corresponding plant protection product *can* be used effectively and safely to control certain pest infestations in certain crops when used in accordance with the associated conditions of use. Of itself, approval offers no guarantee that a given product will always be used effectively and safely in practice.

The Committee just gives an outline description of how the risks to human health are assessed. More comprehensive descriptions of a more technical nature can be found in a draft guideline by the European Commission[230] and in the Board for the Authorisation of Plant Protection Products and Biocides' Evaluation Manual for Plant Protection Products.[231-234]

Groups to be protected

The assessment of the risks posed by plant protection products to human health focuses on the safety of operators who work with plant protection products and on the safety of those who, after the application, can come into contact with plant protection products or their conversion products. The first group includes those who make occupational use of such products (farmers, growers, and agricultural contractors) and private users. The second group includes those who, some time after spraying has been completed (there is a prescribed period for this), carry out activities in the crop, bystanders and passers-by (who may or may not be in the area for occupational reasons during spraying), and local residents. The second group also includes the consumers of sprayed food crops. This is because traces of the plant protection product (residues) can remain in the crop. Of course, an assessment of the risks to consumers is only carried out where a product is being applied to a crop that is intended for human (or animal) consumption. Table 1 provides detailed descriptions of these groups of exposed individuals, which correspond to those used in the EU in connection with the approval of plant protection products.

In all cases, the assessment system follows the same pattern. Health-based limit values for exposure are established on the basis of toxicity data about the product, which manufacturers are required to submit. Models are used to estimate the exposure of the above-mentioned groups to the product in question, based on the procedure proposed by the manufacturer for using and applying said product. If the exposure calculated in this way is below the health-based limit value, then the product is approved.

The whole concept of health-based limit values is based on the assumption that toxicity has a threshold value. This is because living organisms, including humans, have a certain capacity to avoid or neutralise a substance's adverse effects. Health effects only occur when exposure is so high that this capacity is no longer sufficient. Current thinking is that, in the case of substances that can cause cancer by damaging genetic material, it is impossible to determine a safe level of exposure. Such compounds would not normally be approved as plant protection products.[235] It is assumed that substances that cause cancer in other

ways only do so above a certain threshold value. Thus health-based limit values can be established for such substances.

Table 1 Groups of people who are taken into consideration during the risk assessment.

Name	Description
Operator	Operators are persons who are involved in activities relating to the application of a plant protection product (PPP); such activities include mixing/loading the product into the application machinery, operation of the application machinery, repair of the application machinery whilst it contains the plant protection product, and emptying/cleaning machinery/containers after use. Operators may be either professional (e.g. farmers or contract applicators engaged in commercial crop production) or amateur users (e.g. home garden users).[8]
Worker, re-entry worker	Workers are persons who, as part of their employment, enter an area that has been treated previously with a plant protection product, or who handle a crop that has been treated with a plant protection product.[8]
Bystander	Bystanders are persons who are located within or directly adjacent to the area where plant protection product (PPP) application or treatment is in process or has recently been completed; whose presence is quite incidental and unrelated to work involving PPPs, but whose position might lead them to be exposed; and who take no action to avoid or control exposure.[8]
Local resident	Local residents are persons who live, work or attend school or any another institution adjacent to an area that is or has been treated with a plant protection product (PPP); whose presence is quite incidental and unrelated to work involving PPPs but whose position might lead them to be exposed; who take no action to avoid or control exposure; and who might be in the location for 24 hours per day.[8]
Consumer	Consumers are individuals who eat products of plant or animal origin that may contain plant protection product residues.

Health-based limit values for ingestion or exposure

Two health-based limit values are established for individuals consuming food crops that have been treated with plant protection products: one for long-term intake (ADI) and one for peak intakes (ARfD). A single health-based limit value (A(O)EL) is usually established for operators, workers, bystanders and local residents (see Table 2). It focuses on the safety of prolonged exposure. No safe level is determined for peak exposures at the present time.[8]

Table 2 Health-based limit values that are considered to be safe for the ingestion of, or exposure to, plant protection products.

Health-based limit value	Abbreviation	Description	Target group
Acceptable Daily Intake	ADI	an estimate of the maximum amount of a substance, expressed per kilogram of body weight, that can be ingested on a daily basis over a lifetime with food and/or drinking water without an appreciable health risk to the consumer, based on all known facts at the time of the assessment.	Consumers
Acute Reference Dose	ARfD	an estimate of the maximum amount of a substance, usually expressed per kilogram of body weight, that can be ingested over a period of 24 hours or less with food and/or drinking water without an appreciable health risk to the consumer, based on all known facts at the time of the assessment.	Consumers
Acceptable (Operator) Exposure Level	A(O)EL	the maximum amount of an active ingredient to which the operator, worker, bystander, or local resident may be exposed without suffering any adverse effects to their health. The A(O)EL is expressed as milligrams of substance per kilogram of body weight per day. A(O)ELs relate to the internal (absorbed) dose that is available for distribution throughout the body after being absorbed through any exposure route.[230]	Operators Workers Bystanders Local residents

These health-based limit values are derived in two steps. The first step involves the characterisation of the substance's potential hazards, both qualitatively and quantitatively. To that end, the manufacturer must perform a series of toxicity tests. For ethical reasons, these tests are not carried out on human beings; instead experimental animals (usually rats, mice, rabbits and dogs) are used for this purpose. These tests must be carried out according to precise guidelines, issued by the OECD. They must also meet the quality requirements for 'Good Laboratory Practice' which have also been defined by the OECD.[236] Manufacturers often contract this testing out to specialised laboratories in the Netherlands and elsewhere. The tests are designed to detect the substance's critical effect. This is the first adverse effect to appear, i.e. at the lowest level of exposure. Table 3 gives a summary of the requisite tests. If the results warrant it, or if, on the basis of knowledge of the substance's mechanism of action, it is considered necessary, the manufacturer is required to carry out supplementary tests that specifically target a given problem. Typically, the experimental animals

are exposed orally, i.e. via the mouth. In a few studies, they are exposed via the skin or the respiratory system.

Table 3 Requisite toxicity studies.

Type of study	Targeting
Toxicokinetics	Fate of the substance in the body: absorption, distribution, conversion, excretion
Acute toxicity	Effects of a single exposure
Irritation	Irritation of skin and eyes
Sensitisation	Hypersensitivity following skin exposure
Sub-acute and semi-chronic toxicity	Effects of repeated exposure (4 weeks - 3 months)
Chronic toxicity	Effects of prolonged exposure (> 1 year)
Carcinogenicity	Cancer
Genotoxicity	Damage to genetic material
Neurotoxicity (if there is a reason to do so)	Damage to the nervous system
Reproductive toxicity	Disruption of reproduction and effects on the offspring (2 generations)
Developmental toxicity	Structural abnormalities in the foetus

Acute toxicity, expressed in terms of LD50/LC50 (the dose/concentration at which fifty percent of the experimental animals die), is usually relatively insignificant in terms of exposure under normal conditions of use. It is mainly important in the event of accidents or intentional poisoning. The data are used to determine which risk and safety phrases should be printed on the label. Of greater relevance are the effects that occur following repeated exposure to lower doses. The studies that target these effects are used to derive No-Observed-Adverse-Effect Levels (NOAELs). A NOAEL is the highest concentration or dose used in a test at which no adverse effect is observed. Thus, the series of toxicity studies generates a set of NOAELs. The lowest of these NOAELs is the dose at which the critical effect does not occur, which means that there are no other effects either.

Unless there are good reasons not to do so, this lowest NOAEL is used to derive the ADI for humans. This is usually the NOAEL from the chronic toxicity study, the reproductive toxicity study or the developmental toxicity study in experimental animals.

The ADI is a limit for the chronic exposure suffered by consumers. Accordingly, a short-lived, limited breach will not necessarily pose an immediate health risk, provided that the average daily intake over a more protracted period does not exceed the ADI. The ARfD sets out a limit that exposure peaks of this kind must not equal or exceed. Thus the ARfD is always equal to, or higher than, the ADI. The ARfD is derived only for products with high acute toxicity. It is

calculated from a NOAEL for an acute toxic effect. Neurotoxicity and effects on the developing organism are some of the relevant effects. One problem here is that the toxicological testing requirement is not yet sufficiently focused on deriving an ARfD. As a result, this derivation is often based on effects that might not occur after just a single exposure, but only after a series of brief, repeated exposures.

The A(O)EL is usually based on a NOAEL from a sub-acute or semi-chronic toxicity study, or from a neurotoxicity study, a reproductive toxicity study, or a developmental toxicity study. The idea behind this is that a given product against a given disease or pest in a given crop is not usually applied for more than three months per year. Where there is a good reason for doing so, a NOAEL from a chronic study in experimental animals can also serve as a starting point. The exposure suffered by operators, workers and bystanders mainly takes place through the skin and the respiratory system. However, the A(O)EL is generally based on oral studies (via the mouth) in experimental animals, because most studies tend to focus on the oral route. If, based on all the data in the dossier, there is evidence that the type and magnitude of the effects involved is independent of the exposure route, then route-to-route extrapolation is used, which means that A(O)EL can be derived from oral studies.

In order to derive health-based limit values from the selected NOAELs, in a second step these values are divided by a safety factor (or uncertainty factor). By default this is a factor of 100. This is composed of two sub-factors of 10. The first sub-factor is intended to compensate for the fact that the toxicity data was obtained from experimental animals and not from humans. Thus, to be on the safe side, it is assumed that the human NOAEL is a factor of 10 lower than that of the experimental animal in question, and that humans are therefore ten times more sensitive. The use of the second factor of 10 is dictated by the fact that people can differ in terms of sensitivity. The goal is not only to protect those of average sensitivity, but also those who show increased sensitivity due to factors such as their genetic makeup, nutritional status, health status or age. For this reason, the established health-based limit values are a factor of 100 lower than the measured ‘no effect level’ in the experimental animal study that is considered to be most relevant. Where relevant, for instance when the critical effect is a very serious effect, as in the case of tumours, the safety factor is increased correspondingly and the health-based limit value is set at an extra-low level.

The ADI, ARfD and the A(O)EL are established at EU level. These values are not set in stone. They are updated when necessary, as new scientific information becomes available.

Estimating human exposure

General principle

Based on a plant protection product's method of application, as proposed by the manufacturer, models are used to estimate anticipated human exposure levels. Where a product is being used to treat a food crop, the exposure suffered by consumers is also estimated, as well as that of operators, workers and bystanders. In the case of applications in non-food crops, the calculation of exposure focuses solely on operators, workers and bystanders. The first step, for all groups, is to make a simple, rough estimate (the first tier). This is based on the assumption that every single condition is unfavourable; that is, it will result in a high level of exposure (worst case calculation). It is assumed, however, that the product will be applied in accordance with the conditions of use. The admissibility assessment makes no allowance for inept, careless or illegal use. If the exposure calculated in this way is below the level that is considered safe (health-based limit value), then the proposed use can be approved in this regard. If the estimated exposure is higher, then more refined calculations are carried out based on conditions that more closely reflect the situation in everyday practice, such as wearing protective clothing (the second tier). If the estimated exposure is still too high, however, then the product will not be granted approval, at least not with regard to the proposed method of application.

Exposure calculation for consumers

The extent to which the food they eat exposes consumers to traces of plant protection products depends on what they eat, how much of it they eat, and on the concentrations of plant protection products involved. Details of Dutch people's patterns of consumption are obtained from the Food Consumption Surveys (see http://www.rivm.nl/Onderwerpen/V/Voedselconsumptiepeiling). A distinction is also drawn between the patterns of consumption in adults and those in children. There are internationally established legal limits for the concentrations of plant protection products in food (Maximum Residue Limits, MRLs). These are not health-based limits, but limits that are based on 'good agricultural practice', which, in the context of efficient pest control, is the maximum level remaining in the crop at harvest time. The actual levels are generally much lower. Based on patterns of consumption and the MRLs, a worst case estimate of chronic exposure is made. If this is close to or above the ADI,

then more refined calculations are carried out based on measured residue levels. These also take into account food preparation methods (peeling, pressing, cooking, etc.) that may affect these levels. Peak exposures are estimated on the basis of portion sizes and the variation in residue levels between individual pieces of fruit and vegetables. Worst case estimates involve the combination of high residue levels and extra-large portion sizes. These exposures are assessed against the ARfD. If the final exposure estimates exceed the ADI or ARfD, then the proposed MRL is not implemented in law, which means that the plant protection product application in question will lapse.

Exposure calculation for operators and workers

The exposure suffered by operators, workers and bystanders is estimated using model-based calculations. In the case of operators, estimates are made of the exposure they suffer during various activities, such as preparing the spraying liquid, filling the application equipment, and spraying. The contributions from each of these individual pathways are totalled. The calculations take into account a large number of variables that are characteristic (either completely or partly) of the Netherlands. These are whether the spraying liquid is prepared from a powder, granules or liquid, the number of hours per day spent preparing spraying liquids, the number of hectares treated per day, the number of hours spent spraying per day, and the spraying method used. It is assumed that the average operator is an adult with a body weight of 70 kg. The basic assumption is that operators wear normal clothing (or work clothing). If the calculated exposure exceeds the A(O)EL, then a new calculation is performed, based on the assumption that the operator will be using personal protective equipment, such as gloves.

For workers, the basic assumption of what constitutes a worst case is that they wear normal clothing (or work clothing) and that they come into contact with freshly applied spraying liquid. If necessary, a more refined estimate can be made in this case too. This would involve allowing for the use of personal protective equipment, where that is realistic, and for the disappearance of a portion of the plant protection product during the prescribed period between spraying and the moment that the worker enters the treated area. Here, too, it is assumed that the average operator is an adult with a body weight of 70 kg.

Exposure calculation for bystanders and local residents

In the Netherlands, it is currently assumed that bystanders are individuals who, for occupational reasons, are in the vicinity of the area that was/is being sprayed. Casual non-occupational bystanders are excluded. The assumption is that any bystanders are situated on the margins of the treated area. That is a realistic worst case assumption. In every case, it is assumed that they do not wear any personal protective equipment, that any clothing that they do wear does not provide any protection whatsoever (naked bystander), and that the entire body (both front and rear) is exposed. The assumption is that these individuals are adults with a body weight of 70 kg and an exposed body area of $2m^2$. The latter is a significant overestimation.

In the Netherlands, exposure estimates are currently only made for those living in the vicinity of greenhouses, and for children and adults spending time on lawns that have been treated with a plant protection product. It is assumed that the risk assessments for bystanders, in particular, are sufficiently 'worst case' to cover the risks posed to all other local residents. This means that, as yet, no separate assessment is made of the risks to local residents. However, some other European countries (Germany and the UK) have recently started doing so.[219,220] According to the recently implemented European Regulation (EC) 1107/2009, the specific risks to local residents should also be determined. EU harmonisation with regard to this matter is currently in preparation.

Annex I

Glossary

Acceptable Daily Intake

An estimate of the maximum amount of a substance that can be ingested on a daily basis over a lifetime with food and/or drinking water without an appreciable health risk to the consumer, based on all known facts at the time of the assessment. This is expressed as milligrams per kilogram of body weight.

Acceptable (Operator) Exposure Level

The maximum amount of an active ingredient to which the operator, worker, bystander, or local resident may be exposed without suffering any adverse effects to their health. The A(O)EL is expressed as milligrams of substance per kilogram of body weight per day. A(O)ELs relate to the internal (absorbed) dose that is available for distribution throughout the body after being absorbed through any exposure route.

Acute Reference Dose

An estimate of the maximum amount of a substance, usually expressed in milligrams per kilogram of body weight, that can be ingested over a period of 24 hours or less with food and/or drinking water without an appreciable health risk to the consumer, based on all known facts at the time of the assessment.

ADI

See ‘Acceptable Daily Intake’

Aggregate exposure

Exposure to a single substance from all sources and via all pathways.

Agrotoxin

Another term for 'Plant Protection Products'.

A(O)EL

See 'Acceptable (Operator) Exposure Level'

ARfD

See 'Acute Reference Dose'

Bias

Distortion of the associations between exposure and health status, caused, for example, by the method used to select the study population, or by an incorrect determination of exposure or health status.

Biocides

Preparations used for purposes such as the control of pests in buildings and other structures, wood preservation, disinfection, and for inhibiting the fouling of ship hulls (antifouling). These substances contain partly the same (or similar) chemicals that are used in plant protection products.

Biological Monitoring

See 'Biomonitoring'

Biomarker

A substance that can be used as an indicator or measure of exposure to a chemical substance or physical agent.

Biomonitoring

The measurement of chemical substances, or their metabolites, in body fluids, tissues or excretory products.

Biomonitoring equivalent

A health-based limit value for a chemical substance in a biological sample (e.g. blood or urine) that is consistent with a selected health-based limit value such as the ADI or A(O)EL. It can be derived from these values using information on the toxicokinetics of the substance in question.

BREAM

The Bystander and Resident Exposure Assessment Model

Buffer zone

A strip of land between the cultivated part of an area of land and a non-target area (e.g. a watercourse), in addition to the minimum agricultural cultivation-free zone.

Bystanders

Bystanders are persons who are located within or directly adjacent to the area where plant protection product (PPP) application or treatment is in process or has recently been completed; whose presence is quite incidental and unrelated to work involving PPPs, but whose position might lead them to be exposed; and who take no action to avoid or control exposure.[8]

Carcinogenicity

The ability of a substance to cause cancer.

Case-control study

A type of epidemiological study in which researchers select a group of patients with the disease in question. Each patient is then linked to one or more healthy control subjects who, in all other respects, have as much in common with that patient as possible. The patients' exposure to certain plant protection products (in this case) is then compared to the exposure suffered by the control group. If the patients are found to have suffered a systematically higher level of exposure than the control subjects, then that would be an indication of causality. This approach is particularly suitable for studying the causes of rare disorders. However, it suffers from the drawback that the exposure suffered by patients and control subjects has to be reconstructed retrospectively, on the basis of what the participants are able to recall, for example. That is not always a reliable source of information. The better the reconstruction, the greater the strength of the evidence generated by the study.

Co-formulants

All of the substances contained in a plant protection product, apart from the active ingredient (or active ingredients).

Cohort study

A type of epidemiological study in which researchers monitor a large group (a cohort) of initially healthy participants over a protracted period of time. Depending on factors such as the health effect being studied, this can vary from several years to several decades. Data on exposure levels (in this case to plant protection products) and on the occurrence of diseases are recorded over time. Then, after sufficient time has passed, it can be established whether or not the two are interconnected. While studies of this kind can be carried out retrospectively, they are usually prospective in nature. This means that, in theory, the level of exposure involved can be reliably

determined. If that is indeed the case, then prospective cohort studies will deliver the strongest evidence. The method is only suitable for relatively common diseases. In the case of rare disorders, a very large group of people will have to be monitored over time if sufficient cases of disease are to be detected.

Computer calculations of exposure for a scenario

Calculations involving the use of a computer model, in which the input data are derived and formulated for a specific scenario that has to be assessed.

Confounding

A disruption of the association between exposure and health status, which may occur if insufficient account is taken of other risk factors. This would apply, for instance, to a supposed association between exposure to plant protection products and lung cancer, if no correction were made for the smoking habits of exposed individuals.

Consumer

The term 'consumer' can be used in two ways, in a biological or an economic sense. In the first case, the consumer is an organism that feeds on other organisms (plants, animals). In the second case, the consumer is someone who makes use of goods and/or services. Legislation in the area of food safety (such as the Regulation on plant protection product residues) uses 'consumer' in the biological sense of the term. Legislation in the domain of non-food substances (e.g. industrial chemicals, biocides) uses 'consumer' in the economic sense of the term. This is sometimes confusing, as someone who uses an insecticide in their vegetable garden is termed a 'non-professional user' (plant protection product terminology) but if that same individual uses the same insecticide inside their home then they are classified as a 'consumer' (biocide terminology).

Cross-sectional study

A type of epidemiological study in which the participants' exposure and health status are determined at the same point in time.

Cumulative exposure

Simultaneous exposure to several substances (such as plant protection products). The term generally applies to substances that have the same mechanism of action, such as inhibiting the same enzyme in the body.

Degradation product

A substance that arises from a parent compound as a result of breakdown processes. These processes can be either biotic or abiotic

in nature. The molecules of a degradation product can be larger than those of the parent compound. See also ‘Metabolite’

Droplet drift

The loss of spray during application, measurable near the sprayed field (as downwind soil deposition) after the sedimentation of spray droplets for a period of up to several minutes following application (~ 15 minutes).

Dry deposition

The removal of vapour and particles from the air by deposition on the soil, on plants, or on water surfaces, in the absence of precipitation.

Early warning system

A system that allows pest infestations to be detected at an early stage.

Ecological study

An ecological study is the simplest type of epidemiological study. Exposure and the presence of disease are both tracked at the level of the community rather than at individual level. Villages, local authorities or communities are compared to one another in terms of the occurrence of certain disorders or health characteristics (such as the number of hospitalisations) and the exposure factor in question, in this case the use of certain plant protection products. One advantage of this type of study is that it can be carried out relatively easily and quickly. It suffers from the major drawback, however, that the communities being compared often differ from one another in numerous other ways (age structure, genetic factors, lifestyle, etc.). Any corrections made at ecological level are not always effective, which can result in false conclusions being drawn (‘ecological fallacy’). It is often not possible to ascertain which factor (or combination of factors) is responsible for the observed difference in disease burden. Accordingly, studies of this kind are particularly useful for obtaining preliminary evidence in situations where much is still unknown. The strength of the evidence for a causal relationship is rather limited.

Emission

The emission or transfer of plant protection products (in this case) from the treated area of land or structure. The borders used to delimit this concept are usually the borders of the area of land in question, the top of the crop (at maximum height) and one metre below the surface. In greenhouses, the upper limit is defined by the structure’s roof.

Epidemiological study

The search for a link between the occurrence of certain disorders and certain risk factors, including environmental factors.

Epigenetics

A sub-field of genetics that investigates the influence of reversible heritable changes in gene function that occur in the absence of changes to the base-pair sequence of the DNA in the cell nucleus.

External exposure

Exposure to a substance through the skin, respiratory system, or digestive tract. Usually estimated on the basis of measurements of concentrations or levels of the substance in air, water, soil, food, or other media with which the body comes into contact.

Harm

The deterioration of 'something' of value, which is detrimental to that value. The exact nature of that 'something' of value can be anything to which people attach value, all manner of material and immaterial assets such as buildings, art, agricultural crops, scenic beauty, ecosystems, biodiversity, freedom and human health.

Harmful

That which causes harm.

Hazard

A hazard is 'something' that has the potential to cause harm. That potential is based on an inherently threatening characteristic that, under certain circumstances, may cause harm. That 'something' could be anything – such as people, animals, plants, bacteria, viruses, volcanoes, geological faults, the weather, equipment, or products. Thus it could also be a plant protection product. If a hazard comes into contact (or has the potential to come into contact) with something of value, then there is a risk of harm.

Hazardous

Having the potential to cause harm.

Health-based limit value

Level of exposure to a hazardous agent below which no appreciable adverse effect on health is expected, based on current scientific knowledge. Some examples are the ADI, the ARfD and the A(O)EL.

Incident investigation (in relation to chemical substances)

Research into the effects of an unexpected, usually brief but high level of exposure (involving humans or animals) to chemical substances. This type of investigation is, of course, invariably retrospective. It

focuses on the identities of the victims, the nature of their health problems, the chemical substances involved (in this case, plant protection products), the identified exposure levels and pathways, and details of the circumstances that gave rise to the incident in question. The agencies typically involved in such investigations are the municipal health services (GGDs), the National Institute for Public Health and the Environment's National Poisons Information Centre (NVIC) and various affiliated inspectorates, such as the Netherlands Food and Consumer Product Safety Authority (NVWA), the Inspectorate SZW and the Human Environment and Transport Inspectorate. Information unearthed by investigations of this kind makes it possible to provide the best possible assistance to victims, while helping to avoid further incidents. Various bodies involved in these matters publish annual reports about notified incidents. Incident investigations are occasionally incorporated into case-control studies, to gain an understanding of the determinants involved.

Internal exposure

The body burden of harmful substances, such as plant protection products or their metabolites, for example in blood or urine. See also 'Biomonitoring'

Kinetics (or toxicokinetics)

The fate of a toxic substance in the body: absorption, distribution, conversion, and excretion.

Local residents

Local residents are persons who live, work or attend school or any another institution adjacent to an area that is or has been treated with a plant protection product (PPP); whose presence is quite incidental and unrelated to work involving PPPs but whose position might lead them to be exposed; who take no action to avoid or control exposure; and who might be in the location for 24 hours per day. The Committee firmly includes farmers and growers themselves, and their families, in the category of 'local residents', inasmuch as they live near treated land. The Committee uses the term 'adjacent to' to refer to 'distances of less than 100 m'.

Metabolite

The conversion product of parent compounds produced by metabolic processes in the bodies of organisms; the molecules of a metabolite can be larger than those of the parent compound.

Model

In a scientific or technical context, a model is a simplified representation, description or simulation of an aspect of reality, usually taking the form of a number of mathematical equations. Before a model can be used, specific input data must be obtained. The models referred to in this advisory report can be used to perform quantitative calculations, for example on human exposure to plant protection products. This requires input data on aspects such as the volatility of the substance in question and its solubility in water.

Neurotoxicity

A substance's potential to damage the nervous system.

NOAEL

See 'No-Observed-Adverse-Effect Level'

No-Observed-Adverse-Effect Level

The highest concentration or dose of a substance being tested in experimental animals at which the effect produced is not statistically different from that in untreated control subjects.

Operator

Operators are persons who are involved in activities relating to the application of a plant protection product (PPP); such activities include mixing/loading the product into the application machinery, operation of the application machinery, repair of the application machinery whilst it contains the plant protection product, and emptying/cleaning machinery/containers after use. Operators may be either professional (e.g. farmers or contract applicators engaged in commercial crop production) or amateur users (e.g. home garden users).[8]

Passers-by

The Committee does not distinguish between bystanders and passers-by. See 'Bystanders'

Persistence

Resistance to conversion or breakdown.

Pesticides

Collective term for 'Plant Protection Product' and 'Biocides'.

Plant protection product

An active ingredient or a preparation containing one or more active ingredients, to be used in order to: 1) protect plants or plant products from all harmful organisms or prevent such organisms from inflicting harm; 2) influence the living processes of plants, but without involving any nutrients; 3) store vegetable products; 4) kill unwanted

plants or 5) destroy parts of plants or prevent or inhibit the unwanted growth of plants.

Reproductive toxicity

Potential to disrupt reproduction and affect the offspring.

Residues

Residues (parent compounds, conversion products or metabolites) of plant protection products that can remain on or in agricultural products, such as fruit and vegetables, after application.

Risk

The chance, with a certain degree of probability, of harm to health, to the environment, and to goods, in combination with the nature and extent of the harm in question. Risk only arises when there is exposure to a hazard, or when there is the possibility of such exposure.

Safe

Where any risk involved remains within accepted limits. Accordingly, 'safe' is not an absolute concept, in the sense of 'out of danger' or 'risk-free'. While the Netherlands is generally considered to be a safe country, people here still occasionally fall victim to natural disasters, accidents, and crime. So safety should actually be seen as a relative concept. The Committee is at pains to point out that, in many cases, no further details are provided regarding the exact parameters of these accepted limits. These also cannot be entirely disengaged from the societal benefits associated with risky actions or risky technologies. Of course, individuals or stakeholders may disagree about exactly what benefits can justify what specific risks. As a result, they may also disagree about whether or not something should be designated as 'safe'. In addition, there is the matter of distributional issues – who stands to benefit and who will have to bear the burden? When all is said and done, setting a target safety level is a political matter. Thus, even if a degree of risk is considered acceptable, this does not detract from the fact that harm is seen as undesirable. Accordingly, there is an unceasing effort to find cost-effective ways of reducing risks and enhancing safety.

Safety

The state of being safe.

Scenario

A combination of crop, soil, weather and agricultural parameters used in model-based calculations. The selected scenarios should reflect actual existing situations, which means that the combination of crop,

soil, weather and agricultural conditions must be realistic. 'Representative scenarios' are often used to assess actual or potential risks. This means that situations of this kind must be feasible. The scenario selected is usually the one that leads to the 90th percentile (derived from calculations) of the aspect being investigated.

Sensitisation

Hypersensitivity following skin exposure.

Stable conditions

Atmospheric conditions that limit mixing and dilution. In the present context, the term refers to the structure of the atmosphere close to the surface of the Earth, around ground level. A typical example would be a clear night involving substantial cooling of the Earth's surface, combined with little wind.

Toxicological study

A study of the effects of toxic substances on biological systems, such as humans, animals and plants.

Unstable conditions

Atmospheric conditions that promote mixing and dilution. In the present context, the term refers to the structure of the atmosphere close to the surface of the Earth, around ground level. A typical example would be a cloudless summer day involving substantial warming of the Earth's surface.

Validation process

Comparing model output with independently derived data from experiments or observations in the environment. The input data for the model must also have been obtained independently from experiments or observations.

Vaporisation

The transport of solid plant protection product residues from surfaces (e.g., leaves, soil) to the atmosphere after application, or from droplets of spray during application.

Vapour drift

The drifting of vapour released by the vaporisation of plant protection products from the soil or from a crop after these products have been applied.

Wet deposition

The removal of vapour and particles from the air by precipitation.

Worker

Workers are persons who, as part of their employment, enter an area that has been treated previously with a plant protection product, or who handle a crop that has been treated with a plant protection product.[8]

Worst case

A scenario based on the worst event or series of events that could possibly occur.

Health Council of the Netherlands

Advisory Reports

The Health Council's task is to advise ministers and parliament on issues in the field of public health. Most of the advisory reports that the Council produces every year are prepared at the request of one of the ministers.

In addition, the Health Council issues unsolicited advice that has an 'alerting' function. In some cases, such an alerting report leads to a minister requesting further advice on the subject.

Areas of activity

Optimum healthcare
What is the optimum result of cure and care in view of the risks and opportunities?

Prevention
Which forms of prevention can help realise significant health benefits?

Healthy nutrition
Which foods promote good health and which carry certain health risks?

Environmental health
Which environmental influences could have a positive or negative effect on health?

Healthy working conditions
How can employees be protected against working conditions that could harm their health?

Innovation and the knowledge infrastructure
Before we can harvest knowledge in the field of healthcare, we first need to ensure that the right seeds are sown.

www.healthcouncil.nl